Universität Regensburg

# Team Learning at Work

## Activities, Products, and Antecedents of Team Learning in Organizational Complex Decision-Making Teams

vorgelegt von

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For Felix, who stood by my side all the way writing this book.
I will always love and miss you.

## Abstract

Teamwork is of major importance for organizational success. Team learning is a key concept to explain the advantage of teamwork for organizational performance. Team learning is especially important for organizational complex decision-making teams. However, team learning is not well understood. The questions arise, how team learning activities and products are related, and which antecedents may lead to team learning. Therefore, relations between activities, products, and antecedents of team learning in organizational complex decision-making teams are focused in this thesis. A cross-sectional survey study with overall $N_1$=75 organizational complex decision-making teams was conducted. Data analysis was guided by four research questions. Focusing on antecedents of team learning activities, Research Question 1 asks what beliefs about the team's interpersonal context are related to which team learning activity. Path modelling at the team-level was applied for hypothesis testing. Task interdependence positively predicted all investigated team learning activities. Safe team climate positively predicted knowledge sharing, task reflection, and team process reflection. Team expert roles negatively predicted these team learning activities. Research Question 2 asks about the mediating role of team reflection in the relation between transformational leadership and team innovativeness. To test the formulated hypotheses, conditional process analysis was conducted at the team-level. Team reflection mediated the relation between transformational leadership and team member ratings of team innovativeness. Furthermore, the mediating effect of team reflection was moderated by transformational leadership. However, no significant results were found with respect to team supervisor ratings of team innovativeness. The cognitive team learning product of TMM-TM, which refers to team mental models (TMMs) about team members' occupational (TMM-OC), social (TMM-SC), meta (TMM-MC), and personal competencies (TMM-PC), is focused in Research Questions 3 and 4. Research Question 3 asks how team learning activities are related to TMM-TM. The relation between TMM-TM and the behavioral team learning product of team performance is addressed by Research Question 4. To test the formulated hypotheses, multilevel path modeling was conducted at the team-level. With respect to Research Question 3, it was found that knowledge sharing, task reflection, and team process reflection are positively related to TMM-TM concerning TMM-SC, TMM-MC, and TMM-PC. Basic reflection was positively related to TMM-SC and TMM-PC. With respect to Research Question 4, TMM-MC was positively related to team performance as rated by team supervisors with respect to team effectiveness, efficiency, and innovativeness. Furthermore, TMM-PC was positively related to team innovativeness. Overall, study results deepen our understanding of the complex relations between activities, products, and antecedents of team learning in organizational complex decision-making teams. Moreover, the study sheds some light on the barely researched construct of TMM-TM. Study limitations and implications for practice are discussed.

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**List of abbreviations**

| | |
|---|---|
| BR | basic reflection |
| CFA | confirmatory factor analysis |
| CFI | comparative fit index |
| CV | control variable |
| DV | dependent variable |
| EFA | exploratory factor analysis |
| GTL | global transformational leadership scale |
| ICC | intraclass correlation coefficient |
| IMM | index of moderated mediation |
| IV | independent variable |
| KMO | Kaiser-Meyer-Olkin coefficient |
| MAP | minimum average partial |
| MLR | maximum likelihood robust |
| PAF | principal axis factoring |
| RMSEA | root mean square error approximation |
| SEM | structural equation modeling |
| SRMR | standardized root mean square residual |
| STC | safe team climate |
| TL | transformational leadership |
| TLI | Tucker-Lewis index |
| TMM | team mental model |
| TMM-MC | team mental model-meta competence |
| TMM-OC | team mental model-occupational competence |
| TMM-PC | team mental model-personal competence |
| TMM-SC | team mental model-social competence |
| TMM-TM | team mental model-team model |
| TMR | team member ratings of team innovativeness |
| TMS | transactive memory system |
| TPR | team process reflection |
| TR | task reflection |
| TSR | team supervisor ratings of team innovativeness |
| VIF | variance inflation factor |

# 1. Introduction: Examining the relevance of team learning in organizational complex decision-making teams

Teams have become a central element in the structure of organizations (Knapp, 2010). Many organizations organize their work around teams in order to deal with increasingly complex and turbulent economic conditions (Kozlowski & Bell, 2008). Teamwork is a powerful tool that enables organizations to learn, develop, and adapt to changing circumstances (Moran, 2005). But why are teams so valuable for achieving organizational development and performance? It is assumed that teams have greater potential than individuals in successfully solving tasks that are complex and require innovative and comprehensive solutions (Salas, Sims, & Burke, 2005; Van der Vegt & Bunderson, 2005). As teamwork enables employees to combine their individual knowledge, skills, and experiences, teams may develop solutions to tasks that are superior to solutions developed by individuals (Argote, Gruenfeld, & Naqin, 2001; Jackson, 1996; Sessa & London, 2008a). Thereby, team learning is a crucial element of the teamwork process. Combining their individual knowledge, skills, and experiences to reach a common goal, the collaboration of team members is crucially characterized by the phenomenon of team learning. Through team learning, the knowledge of individual team members is transformed and integrated into a team-level property that enhances the performance of the team as an entity (Gubbins & MacCurtain, 2008; Kozlowski & Ilgen, 2006).

> The concept of group or team learning refers to the acquisition of knowledge, skills, and performance capabilities of an interdependent set of individuals through interaction and experience. Team learning is fundamentally based on individual learning, but when viewed as more than a mere pooling of individual knowledge it can be distinguished as a team-level property that captures the collective knowledge pool, potential synergies among team members, and unique individual contributions. (Kozlowski & Ilgen, 2006, p. 86)

Thus, team learning is crucial for capitalizing on the knowledge, skills, and experiences of individual team members during cooperative problem-solving as it turns these individual competencies into a united team-level property enhancing team performance. Therefore, team learning is a key concept explaining the advantage that teamwork brings about for organizational performance, and understanding team learning is crucial for predicting organizational performance (Wilson, Goodman, & Cronin, 2007). Moreover, team learning has been proposed to be a necessary requirement for organizational learning and development (Senge, 1990). However, as noted by Knapp (2010): “The development of collective learning

in specific work contexts is not well understood, yet has become critical to organizational success" (p. 285). Therefore, the overarching aim of this dissertation is to contribute to a better understanding of team learning in organizational work contexts.

Jehn and Rupert (2008) define the organizational team as "a social system of at least two members who (a) recognize themselves as a group, (b) are recognized by others as a group, (c) have a shared responsibility for a team product or service, and (d) operate in an organization" (p. 125). As this definition is quite broad, it cannot be assumed that team learning is equally important for all kinds of organizational teams that fit this definition. The relevance of team learning is crucially determined by the nature of a team's task (Sessa & London, 2008b). With respect to the nature of teamwork tasks, teams may be distinguished into knowledge work teams and physical work teams (Devine, 2002). Knowledge work teams typically deal with intellectual tasks that require cognitive skills and involve the development of new knowledge and solutions to complex problems in a nonlinear work process (e.g. management team). Physical work teams typically deal with physical work tasks that require physical skills and are drawn out in a linear work process (e. g. production team). Elaborate team learning activities, like discussing and debating competing perspectives, are especially important for team performance in knowledge work teams dealing with intellectual tasks that are (1) complex, meaning that team members need to combine and integrated various task components, (2) unstructured, meaning that the task allows for multiple courses of action, goals and possible solutions, and (3) non-routine, meaning that substantial elements of the task or the work environment can change daily in hardly predictable ways (Carter & West, 1998; Dayan & Basarir, 2010; Hagen & Aguilar, 2012; Jehn, Northcraft, & Neale, 1999, West, 1996). „When a task is complex and not well understood, however, discussing and debating competing perspectives and approaches is essential for group members to identify appropriate task strategies and to increase the accuracy of members' assessments of the situation" (Jehn et al., 1999, p. 747). Accordingly, the discussion of different perspectives on a complex, ill-structured problem to develop new solutions is presumably more important for decision making in a top management team than for task execution in a manufacturing team. West (1996) labels teams dealing with this kind of complex, unstructured, and non-routine intellectual tasks *complex decision-making teams.* In this thesis, the focus lies upon organizational complex decision-making teams because, given the complex, unstructured, and non-routine nature of their tasks, team learning is crucial for successful teamwork in these teams (e.g. Boon, Raes, Kyndt, & Dochy, 2013; Edmondson, 1999; Dayan & Basarir, 2010; Van der Vegt & Bunderson, 2005; Van Woerkom & Croon, 2009; Wiedow & Konradt, 2011).

## 2. Activities, products, and antecedents of team learning

Looking at contemporary theoretical models of organizational team learning (e.g. Decuyper, Dochy, & Van den Bossche, 2010; Edmondson, 1999; Knapp, 2010; Van den Bossche, Gijselaers, Segers, & Kirschner, 2006; Van den Bossche, Gijselaers, Segers, Woltjer, & Kirschner, 2011), it becomes apparent that these models mainly consist of three basic dimensions: (1) Some kind of team learning process consisting of team member interaction activities (team learning activities), (2) some kind of team learning outcome or product emerging from these interaction activities (team learning products), and (3) some kind of input consisting of antecedent factors primarily influencing team member interaction activities, but potentially also influencing team learning products as well as the relation between interaction activities and team learning products (antecedents of team learning). Thus, to comprehensively grasp organizational team learning, these three basic dimensions of (1) activities, (2) products, and (3) antecedents of team learning need to be considered. Consequently, the focus of this thesis lies upon team learning activities, team learning products, and antecedents of team learning.

### 2.1. Dimensions of team learning at work: Activities and products

Team learning takes place in and through the collaboration of team members (Van den Bossche et al., 2006). It is a team-level phenomenon insofar as interaction between two or more team members is required for team learning to occur (Dillenbourg, 1999; Dillenbourg, Baker, Blaye, & O'Malley, 1996). As it is not the primary objective of work teams to learn, but to get work done (Sessa & London, 2008a), team learning in the context of organizational work teams is to be understood as a by-product of task execution (Dillenbourg, 1999). Arrow and Cook (2008) define team learning as "a directed or undirected process of shared attention to information that results in an outcome of increased collective access to knowledge, development of shared mental models and expanded ability to satisfy the implicit and explicit goals of the group" (p. 48). Accordingly, the concept of team learning encompasses team learning processes, which are interaction activities of collaboratively focusing and processing information in the team, and products (or outcomes) of these interaction activities attributed to the team as a whole (Steinemann, 2008). In previous research, team learning has mostly been considered either as a process consisting of interaction activities or as a product resulting from interaction activities (Jehn & Rupert, 2008). To gain a more encompassing understanding of team learning in organizations, it is necessary to grasp team learning as encompassing both, the interaction activities that constitute team learning processes as well as the team learning

products resulting from these interaction activities, as well as to investigate the relations between these activities and products of team learning (Wildman et al., 2012).

### 2.1.1. Team learning activities

Team learning activities are to be understood as team processes (cf. Arrow & Cook, 2008; Decuyper et al., 2010). Hence, it needs to be clarified what basically constitutes a team process in order to grasp the concept of team learning activities. Marks, Mathieu, and Zaccaro (2001) define team processes as team members' "interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing taskwork to achieve collective goals" (p. 357). Accordingly, team processes basically consist of team members' interaction activities that are aligned towards a common work goal. Team learning activities are a particular kind of team processes. They consist of interaction activities that are characterized by the aspect of information processing in the team. Considering the definition of team learning given by Arrow and Cook (2008), team learning activities are team processes of collaboratively focusing and processing information at the team-level leading to a change in the team's access to knowledge, its shared mental models, and the range of its potential behaviors. In short, team learning activities are interaction activities of collaborative information processing (cf. Van Woerkom & Croon, 2009). With reference to this understanding of team learning activities, different terms like 'team learning processes', 'team learning activities', and 'team learning behaviors' are used broadly synonymous in the team learning literature (e.g. Decuyper et al., 2010; Jehn & Rupert, 2008; Knapp, 2010; Savelsbergh, Van der Heijden, & Poell, 2009, Van den Bossche et al., 2006; Van Woerkom & Croon, 2009).

Since team learning activities are defined through activities of information processing, the process of information processing in organizations needs to be elaborated for a further differentiation of the concept of team learning activities. Huber's (1991) model of organizational learning distinguishes four processes of information processing in organizations. (1) Knowledge acquisition is the process of acquiring new knowledge or information. (2) Information distribution is the process of sharing and exchanging knowledge or information. (3) Information interpretation is the process of mutually interpreting distributed knowledge or information. (4) Organizational memory encompasses processes of storing and retrieving organizational knowledge and information. Considering these processes as interaction activities at the team-level, it becomes apparent that knowledge acquisition is not a team-level phenomenon, as new information is initially perceived and acquired by

individuals (e.g. Bruner, 1961; Piaget, 1985). In contrast, the processes of information distribution, information interpretation and organizational memory directly apply to the team-level: (1) Information distribution at the team-level is realized by activities of knowledge sharing in the team, (2) information interpretation at the team-level is realized by activities of mutually reflecting on distributed knowledge in the team, and (3) organizational memory at the team-level is realized by team members storing and retrieving knowledge that is shared in the team. Building on these three processes of organizational information processing, team learning activities are conceptualized as interaction activities through which team members collectively (1) share, (2) reflect on, and (3) store and retrieve knowledge.

#### 2.1.1.1. Knowledge sharing

Knowledge sharing is the activity by which team members are passing new information to other team members (Argote et al., 2001). Sharing of new information does not mean that the shared knowledge had to be acquired or created recently, it rather means that the knowledge was latently present but unshared in the team (Decuyper et al., 2010). The process of knowledge sharing is a necessary antecedent of other team learning activities, like the creation of shared knowledge or team reflection (Van den Bossche et al., 2006; Decuyper et al., 2010). It marks a starting point for further team learning activities as information has to be shared first before further processing of that information can be undertaken at the team-level (Van den Bossche et al., 2006). This assumption is consistent with results by Van den Bossche et al. (2011), who report high positive correlations between the team learning activity of construction, which resembles knowledge sharing, and the team learning activities of co-construction and constructive conflict, which aim at the creation of shared knowledge.

#### 2.1.1.2. Team reflection

Team reflection consists of team members' collaborative contemplations manifested in overt verbal interaction activities of discussing the team's tasks, objectives, strategies, and processes (West, 1996). It "involves behaviors such as questioning, planning, exploratory learning, analysis, diversive exploration, making use of knowledge explicitly, planfulness, learning at a meta-level, reviewing past events with self-awareness, digestion, and coming to terms over time with a new awareness" (West, 1996, p. 560). Team reflection helps the team to understand and deal with its current tasks and environments, and to approach new challenges (West, 1996; Dayan & Basarir, 2010). In complex decision-making teams, team reflection is especially important as it can help team members to develop shared

understandings and methods for successful task accomplishment under changing and challenging circumstances (Carter & West, 1998).

Team reflection is a complex construct that encompasses different objects as well as different depth-levels of reflection (Schippers, Den Hartog, & Koopman, 2007). To better grasp the complexity of team reflection, Høyrup (2004) proposes a theoretical distinction of team reflection into the activities of reflection and critical reflection. Whereas reflection consists of team members' collaborative contemplations that are focused on immediate issues of a task or problem that need to be resolved to proceed with the task, critical reflection involves the questioning of presuppositions in terms of pursued goals, applied strategies and methods, as well as team interaction processes (Høyrup, 2004; West, 1996). Integrating the initial characterization of team reflection based on West (1996), with the theoretical distinction made by Høyrup (2004), with the definition of team learning activities by Arrow and Cook (2008), in this thesis, team reflection in the work context is defined as team members overt verbal interaction activities of collaboratively discussing and contemplating (1) immediate problems and issues that need to be resolved to proceed with the current work task, as well as (2) presuppositions of the teamwork in terms of pursued goals, methods, strategies, and team interaction processes.

In accordance with the distinction of team reflection made by Høyrup (2004), Schippers et al. (2007) empirically identified two different depth-levels of team reflection within work teams. At the level of shallow reflection, the team engages in thinking about issues closely related to the task at hand, whereas the level of moderate reflection "is characterized by a more critical approach toward tasks, goals, strategies, and processes" (Schippers et al., 2007, p. 191). Shallow reflection is triggered by overt problems and issues that appear as work tasks are carried out. Moderate reflection encompasses two distinct aspects. On the one hand, it is reflection on basic assumptions the team's work relies upon, e.g. the accuracy of pursued goals and work methods of the team. On the other hand, it is reflection on team interaction processes, e.g. the process of decision making. However, Schippers et al. (2007) make no explicit distinction between the reflection of basic assumptions and team interaction processes. As several authors highlight reflection on team interaction processes as crucial for successful team performance while handling complex tasks (e.g. Dayan & Basarir 2010; McCarthy & Garavan 2008), it is proposed to widen the frameworks presented by Schippers et al. (2007) by making the distinction between reflection on basic assumptions and reflection on team interaction processes explicit. Thus, three team reflection activities are distinguished in this thesis. (1) *Task reflection* is reflection on overt

problems and issues closely related to the task at hand that need to be resolved to proceed with the current task. Thus, task reflection resembles the notion of shallow reflection. (2) *Basic reflection* is reflection on work related basic assumptions and mechanisms behind successful task accomplishment, e.g. reflection on goals or work methods of the team. (3) *Team process reflection* is reflection on interaction processes within the team, e.g. reflection on communication or decision patterns. Basic reflection and team process reflection resemble the notion of moderate reflection. Integrating the definition of team reflection based on West (1996) with this distinction of three different team reflection activities, it is proposed that team reflection in the work context consists of overt verbal interaction activities of team members collaboratively discussing and contemplating (1) overt problems and issues closely related to the task at hand (task reflection), (2) work related basic assumptions and mechanisms behind successful task accomplishment (basic reflection), as well as (3) team interaction processes (team process reflection).

#### 2.1.1.3. Storage and retrieval

Storage and retrieval refer to team processes that are utilized to store and retrieve explicit and implicit knowledge that is shared by team members and relevant in the team's work context (Oertel & Antoni, 2015). Through storage and retrieval, the collective knowledge of a team can persist and stay usable over time (Decuyper et al., 2010). Wilson et al. (2007) differentiate between three different kinds of storage and retrieval with respect to the type of repository that is used to store and retrieve collective team knowledge. Firstly, given that individual team members develop mental representations that overlap with those of other team members, the memories of individual team members may be used to store and retrieve collective team knowledge. Secondly, team knowledge may be stored in and retrieved from structural repositories, like standardized rules and procedures for carrying out tasks. Thirdly, material repositories, like team documents, minutes, protocols or computer databases, may be used as a formal type of group memory system to store and retrieve team knowledge (Oertel & Antoni, 2015). Storage and retrieval using material repositories requires the codification of knowledge in written language. Thereby, team members transform task-relevant knowledge into concrete concepts which are then written down in paper documents or computer databases, yielding a summary of relevant information, e.g. of the outcomes of a team discussion (Van Woerkom & Croon, 2009). Storage and retrieval by use of material repositories may be especially important for complex decision-making teams, since the codification of knowledge should help these teams to develop a clearer and more shared understanding of task issues that are

complex, unstructured, and non-routine, and also should help team members to put knowledge and ideas into practice (Gibson & Vermeulen, 2003). Therefore, in this thesis, the team learning activities of storage and retrieval are conceptualized as preservation, localisation and utilization of collective knowledge by use of material repositories, like, for example, team documents or computer databases (cf. Van Offenbeek, 2001).

### 2.1.2. Team learning products: Cognition and behavior

Following Arrow and Cook (2008), team learning products are defined as outcomes of team learning activities. More particular, team learning products are "outcome[s] of increased collective access to knowledge, development of shared mental models and expanded ability to satisfy the implicit and explicit goals of the group" (Arrow & Cook, p. 48). Two distinct dimensions are apparent in this definition. The former part of the definition (collective access to knowledge, development of shared mental models) refers to cognitive team learning products, whereas the latter part (expanded ability to satisfy the implicit and explicit goals of the group) refers to behavioral team learning products. Cognitive team learning products consist of declarative, procedural and tacit knowledge structures that team members hold in common and that are developed through activities of sense-making and communication among team members (Stagl, Salas, & Day, 2008). These shared knowledge structures provide team members with a common cognitive framework that empowers the team to respond to complex and dynamic task environments in a synchronized and adaptive fashion (Ensley & Pearce, 2001). Behavioral team learning products "include a wide range of latent competencies that are enacted as manifest performance processes during task episodes" (Stagl et al., 2008, p. 372). Through the behavioral side of team learning the team's shared knowledge is utilized and put into practice (Edmondson, 2002; Zellmer-Bruhn & Gibson, 2006). Thus, behavioral team learning products capitalize on cognitive team learning products and are grasped as the team's task performance.

#### 2.1.2.1. Cognitive team learning products: Team mental models about team member competencies

The shared knowledge structures that comprise the cognitive side of team learning products are captured by the construct of *team mental models (TMM)*. TMM is defined as "organized mental representations of the key elements within a team's relevant environment that are shared across team members" *(*Mohammed, Ferzandi, & Hamilton, 2010, p. 876). The function of TMM is to provide the team with a common cognitive frame to interpret task-

relevant information, to causally explain given problems and situations, and to build shared expectations about future developments (Rouse, Cannon-Bowers, & Salas, 1992). Through TMM team members hold a similar view about their task environment (Mohammed et al, 2010). This allows them to coordinate their work efforts and to adapt to changing circumstances, leading to improved decision making and team performance (Cannon-Bowers & Salas; 2001; Cannon-Bowers, Salas, & Converse, 1993; DeChurch & Mesmer-Magnus, 2010; Klimoski & Mohammed, 1994; Kozlowski & Ilgen, 2006; Levesque, Wilson, & Wholey, 2001; Mohammed et al., 2010). With respect to the content of these shared knowledge structures, Cannon-Bowers et al. (1993, p. 232f) differentiate between four types of TMM. (1) The "equipment model" encompasses TMM about jointly used equipment and tools; e. g. knowledge about a certain computer program. (2) The "task model" contains TMM about the team's task; e. g. about task requirements, performance goals, problems during task execution, or steps in proceeding with the task. (3) The "team interaction model" contains TMM about roles, responsibilities, and interactions of team members; e. g. about the process of decision-making or the flow of information in the team. (4) The "team model" (TMM-TM) contains TMM about the team members themselves, in particular about their knowledge, skills, and work related attitudes.

TMM-TM is crucial to achieve successful planning and coordination in complex decision-making teams (Cannon-Bower et al., 1993). Moreland (1999) puts it as follows:

> When group members know more about each other, they can plan their work more sensibly, assigning tasks to the people who will perform them best. Coordination ought to improve as well because workers can anticipate rather than simply react to each other's behavior (see Murnighan & Conlon, 1991; Wittenbaum, Vaughan, & Stasser, 1998). As a result, they can work together more efficiently, even if task assignments are unclear.... If these claims seem unconvincing, then just imagine a work group (e.g., subjects in most laboratory experiments on group performance) whose members are ignorant about who knows what. In such a group, sensible planning would not be possible. (p. 5)

TMM-TM is important for successful planning and coordination in complex decision-making teams since it is a crucial part of the team's *transactive memory system* (*TMS*). A TMS is a collective memory system to encode, store, and retrieve information and resources that are distributed among team members (Kozlowski & Ilgen, 2006). It combines the knowledge and skills of individual team members with shared TMM-TM knowledge about who has which knowledge and skills (Austin, 2003; Jackson, 2011; Wegner, 1986, 1995). Holding shared TMM-TM knowledge about individual team members' knowledge and skills enables the team

to effectively and efficiently utilize these knowledge and skills (Dayan & Basarir, 2010). This is especially relevant in complex decision-making teams, since an effective, task oriented combination of individual team members' knowledge and skills is required to successfully deal with tasks that are complex, unstructured, and non-routine (Jehn et al., 1999; West, 1996). Consequently, team coordination and performance in complex decision-making teams is fostered by TMS (DeChurch & Mesmer-Magnus, 2010; Kozlowski & Ilgen, 2006; Lewis & Herndon, 2011; Oertel & Antoni, 2015). The conceptual relation between TMM-TM and TMS is schematically depicted in Figure 1. The transactive memory system of the team is restricted by the blue circle. It encompasses two critical components. (1) The individual team members with their respective knowledge and skills. (2) The shared TMM-TM knowledge about which individual team member holds which knowledge and skills. The shared TMM-TM knowledge is represented by the green thought bubble.

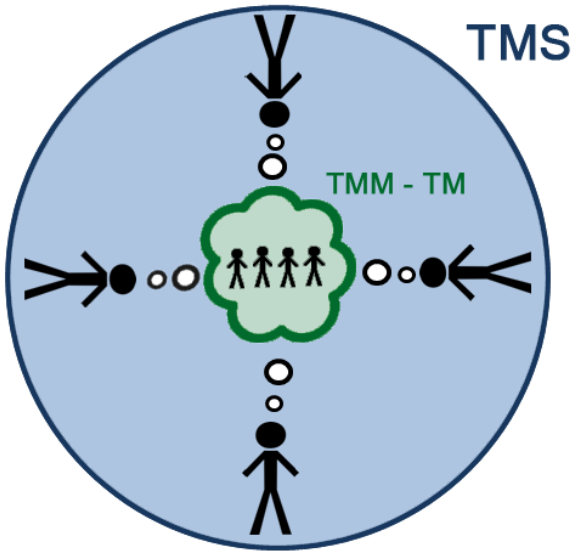


*Figure 1.* TMM team model (TMM-TM) as part of a team's transactive memory system (TMS).

Given their importance for planning, coordination and performance in complex decision-making teams, the shared knowledge structures that comprise the team's TMM-TM are focused in this dissertation. TMM-TM consists of shared knowledge about the knowledge, skills and work related attitudes of team members (Cannon-Bowers et al., 1993). This may also be designated as shared knowledge about team members' vocational competencies. Hence, to grasp the content of TMM-TM, it is necessary to elaborate on the concept of vocational competencies. Mulder (2006) generally defines vocational competence as a personal trait encompassing knowledge, skills and attitudes that are related and situated in the

context of professional practice. With reference to Sonntag and Schmidt-Rathjens (2004), Mulder and Gruber (2011) differentiate (1) *occupational*, (2) *social*, and (3) *meta competence* as three main areas of vocational competence. (1) Occupational competence mainly consists of specific knowledge and skills necessary to deal with vocational tasks, e. g. the ability to operate a certain kind of machine. (2) Social competence encompasses communicative and cooperative abilities that facilitate the realization of goals through social interaction, e. g. the ability to moderate a discussion. (3) Meta competence refers to cognitive abilities that can be used flexibly in various situations and are necessary for a person to autonomously deal with complex and novel tasks, e. g. the ability to solve problems. In addition to these three areas, Erpenbeck and Heyse (1996) as well as Sonntag and Schaper (2006) suggest *personal competence* as a fourth main area of vocational competence. (4) Personal competence consists of personal dispositions, in particular attitudes, moral values, and motives that are reinforcing a person's motivational and emotional involvement in vocational tasks, e. g. a person's confidence or her/his engagement in dealing with vocational tasks. Based on this distinction of four main areas of vocational competence, in this dissertation, TMM-TM is defined as organized mental representations of individual team members' occupational (TMM-OC), social (TMM-SC), meta (TMM-MC), and personal competencies (TMM-PC) that are shared across team members.

#### 2.1.2.2. Behavioral team learning products: Team task performance

A team's task performance stands at the behavioral side of team learning products (Stagl et al., 2008). Task performance of a team is generally defined as an objective or subjective judgment about the degree to which a team achieves its objectives and also about how well these objectives are reached (Hackman, 1987; Salas, Rosen, Burke, & Goodwin, 2009). For an objective judgment of task performance, a quantifiable variable that constitutes an objective criterion of the team's task performance is required. For example, in case of a sales team this may be the number of sales the team makes in a certain period of time, whereas in a production team this may be the number of items produced in a certain period of time. However, in complex decision-making teams acting within authentic work contexts tasks are often unstructured with ill-defined goals and possible solutions allowing for multiple courses of action. Hence, it is difficult to identify objective indicators of team task performance for this kind of teams (Argote et al., 2001). Consequently, objective measures of team task performance have mainly been applied in experimental studies strictly defining and controlling the task and corresponding performance criterions (e. g. Ellis et al., 2003;

Gabelica, Van den Bossche, Segers, & Gijselaers, 2014; Pearsall, Ellis, & Bell, 2010). Furthermore, if tasks differ between teams, as it is often the case in authentic work contexts, it is hardly possible to determine an objective performance criterion that commonly applies to the specific task of each team (Pina, Martinez, & Martinez, 2007). Hence, in field studies investigating teams in their natural work contexts, mainly subjective measures of team task performance have been applied, with the specificity of team performance being subjectively rated by team members or team supervisors (e. g. Edmondson, 1999; Van der Vegt & Bunderson, 2005; Van Woerkom & Croon, 2009; Van Woerkom & Van Engen, 2009; Zellmer-Bruhn & Gibson, 2006).

Team task performance is often treated as a unidimensional construct (Wageman, Hackman, & Lehman, 2005). However, several authors propose that a more appropriate picture of reality in work teams is drawn by distinguishing several distinct dimension of team task performance (e. g. Griffin, Neal, & Parker, 2007; Pina et al., 2007; Van Woerkom & Croon, 2009; Wageman et al., 2005). Van Woerkom and Croon (2009) empirically identified three dimensions of team task performance in work teams: (1) *effectiveness,* (2) *efficiency*, and (3) *innovativeness*.

(1) Team effectiveness is defined as the quality and quantity of teamwork outcomes in terms of attainment of goals and expectations during task execution (Hoegl & Gemuenden, 2001; Janz, 1999; Van Woerkom & Croon, 2009). It heavily depends on the satisfaction of the recipients of teamwork outcomes inside and outside the team and the organization concerning the products and services provided by the team (Spencer, 1994) and is impaired by errors and defects regarding work products and processes of the team (Janz, 1999). To achieve high team effectiveness, goals and expectations formulated by the team members themselves as well as imposed to the team by recipients of its work outcomes inside and outside the organization have to be met by means of high quality teamwork processes and products (Pina et al., 2007; Van Woerkom & Croon, 2009).

(2) Team efficiency is defined by the ratio of the efforts that are put into the realization of teamwork goals (input) and the value linked to the achievement of those goals (output) (Ostroff & Schmitt, 1993; Van Woerkom & Croon, 2009). To increase its efficiency, a team may look for ways to decrease its work efforts and simultaneously increase goal achievement. An efficient team is skilled in dealing with the available resources in terms of time and money, and, therefore, is characterized by the adherence of schedules and budgets (Hoegl & Gemuenden, 2001; Van Woerkom & Croon, 2009).

(3) To grasp the notion of team innovativeness, the concept of innovation must be considered first. Messmann and Mulder (2015) define innovations as "products or processes that are new for a particular organizational or work context and that help to maintain or improve the current state of this context" (p. 125). Thereby, innovation is a non-linear process encompassing creativity and the application of ideas, processes, products, and procedures (West & Sacramento, 2006). Adapting the concept of innovation to the context of work teams, team innovativeness is defined as the intentional introduction and application of ideas, processes, products, and procedures that are new to the team and designed to improve team performance (Van Woerkom & Croon, 2009; West & Farr, 1990). Team innovativeness is not to be confused with team creativity, which has been defined as team behavior that generates original and useful ideas within a social context (Cirella, Radaelli, & Shani, 2014). There are two aspects in which team innovativeness differs from team creativity. Firstly, team innovativeness not only requires the generation of ideas, but also their practical implementation (e.g. Eisenbeiss, Van Knippenberg, & Boerner, 2008; Hüttermann & Boerner, 2011; Nijstad, Berger-Selman, & De Dreu, 2014). Secondly, team innovativeness does not require an idea to be absolutely new, but to be new to the team that is implementing it (Anderson, De Dreu, & Nijstad, 2004; Nijstad et al., 2014). Thus, something that is common practice in one team might be innovative in another team.

## 2.2. Antecedents of team learning

Given sound empirical evidence that team learning is of major importance for team performance (e. g. De Dreu, 2007; Dayan & Basarir, 2010; Edmondson, 1999; Ensley & Pearce, 2001; Tindale, Stawiski, & Jacobs, 2008; Van der Vegt & Bunderson, 2005; Van Woerkom & Croon, 2009; Zellmer-Bruhn & Gibson, 2006), the question arises what leads to the emergence of team learning. Contemporary theoretical models of team learning highlight the social teamwork context, referred to as the team's *interpersonal context*, to be an important antecedent of team learning (e. g. Edmondson, 1999; Decuyper et al., 2010; Knapp, 2010; Van den Bossche et al., 2006). Furthermore, contemporary theoretical models of team learning in organizations highlight the influence of the team leader with respect to team learning (e. g. Bucic, Robinson, & Ramburuth, 2010; Decuyper et al., 2010; Edmondson, 1999; Schippers, Den Hartog, Koopman, & Van Knippenberg, 2008; Vera & Crossan, 2004). In this respect, the construct of *transformational leadership* is particularly relevant (Bucic et al., 2010). Therefore, the following antecedents of team learning are focused in this thesis: (1) The interpersonal context and (2) transformational leadership.

### 2.2.1. Interpersonal Context

Shared beliefs about the team's interpersonal context have been identified as important drivers of team learning activities (Edmondson, 1999; Van den Bossche et al., 2006; Raes, Kyndt, Decuyper, Van den Bossche, & Dochy, 2015; Boon et al., 2013). They consist of team members' cognitively based collective perceptions of work related social bonds and structures within the team (Kozlowski & Bell, 2008; Van den Bossche et al., 2006). In short, these are shared team-level beliefs about the team as a social system. Accordingly, Van den Bossche et al. (2006) describe shared beliefs about the team's interpersonal context as a group-level phenomenon of shared perceptions of the relations among team members that is emerging from group interaction. It encompasses, for example, shared beliefs about the degree of dependency between team members in performing their tasks (task interdependence) as well as about the degree of safety for interpersonal risk taking as conveyed by the social climate of the team (psychological safety; safe team climate). In this dissertation, the focus lies upon three distinct interpersonal context beliefs: (1) Safe team climate, (2) task interdependence, and (3) team expert roles.

(1) A safe team climate is characterized by the shared belief that an ambience of interpersonal trust, mutual respect and support between team members, as well as a non-punitive handling of critical situations and errors is given in the team (Bauer & Mulder, 2011). It is closely related to Edmondson's (1999) construct of psychological safety, which is defined as "a shared belief that the team is safe for interpersonal risk taking.… a sense of confidence that the team will not embarrass, reject or punish someone for speaking up" (Edmondson, 1999, p. 354).

(2) Task interdependence consists of team members' shared beliefs about the extent to which they depend on each other in doing their tasks (Van den Bossche et al., 2006; Van der Vegt, Emans & Van de Vliert, 2001). In case of positive task interdependence, individuals in the team believe that they depend on input from each other and on the successful task execution of their team colleagues for being able to carry out their own tasks (Decuyper et al., 2010; Van der Vegt & Janssen, 2003). Task interdependence is to be distinguished from outcome interdependence, which is defined as the degree to which the achievement of work related goals of individual team members depends on the goal achievement of their teammates (Wageman, 1995). Whereas outcome interdependence may also exist without much cooperation in the team (e. g. in a sales team that has to reach a certain number of sales, whereas sales are undertaken by individual team members), task interdependence requires close cooperation among team members in performing tasks assigned to the team as a whole (Wageman, 1995).

(3) Team expert roles consist of team members' shared beliefs that task-relevant expert knowledge is distributed among team members (Stasser, Stewart, & Wittenbaum, 1995). Team members perceive expert roles to be distinct if they recognize that individual team members hold expert knowledge that is unique within the team. The perception of strong team expert roles is supported by team structures designating specific areas of expertise to single team members (Bunderson & Sutcliffe, 2002).

### 2.2.2. Transformational leadership

Teams are assumed to have greater potential than individuals in successfully solving tasks that are complex and require innovative and comprehensive solutions (Salas et al., 2005). However, teams are not always able to use this potential as teamwork may be undermined by negative side effects of group interaction, such as relationship conflict (Jehn et al., 1999) or groupthink (Janis, 1982). The team leader plays a major role in supporting the team to unfold its potential (Salas et al., 2005), especially with respect to innovativeness (Eisenbeiss et al., 2008; Hüttermann & Boerner, 2011) and team learning (Bucic et al., 2010). Moreover, leadership style has been proposed to be one of the most important predictors of innovation (Rosing, Frese, & Bausch, 2011). A leadership style particularly highlighted in this context is transformational leadership. Transformational leadership is understood as a leadership style to "transform and change the basic values, beliefs, and attitudes of followers so that they are willing to perform beyond the minimum levels specified by the organization" (Podsakoff, MacKenzie, Moorman, & Fetter, 1990, p. 108). "By articulating an attractive vision, developing emotional attachment, and transforming central attitudes, beliefs, and values, transformational leaders move their followers to transcend their own self-interest for a higher purpose or vision (Bass, 1985, 1998; Bass & Riggio, 2006)" (Hüttermann & Borner, 2011, p. 840). Bass (1985) conceptualizes four components of transformational leadership. *Idealized influence* refers to charismatic role modeling behavior of transformational leaders. Applying *inspirational motivation* transformational leaders aim at strengthening the meaning that their followers attribute to work tasks by communicating an inspiring vision. *Intellectual stimulation* means that leaders stimulate their followers to be innovative and creative by encouraging them to question existent assumption, to take another perspective and to approach work situations in new ways. *Individualized consideration* describes the leader's coaching and mentoring activities which are individually tailored to the needs of team members.

## 2.3. Activities, products, and antecedents: Sketching a theoretical model

So far the foundation has been laid to sketch a theoretical model that guides the further investigation. Based on this model, gaps in current theorizing and research are identified. Consequently, four research questions are derived.

### 2.3.1. The links between team learning activities and team learning products

The theoretical link between team learning activities and team learning products is already immanent in the definition of team learning by Arrow and Cook (2008), who define team learning as "a directed or undirected process of shared attention to information that results in an outcome of increased collective access to knowledge, development of shared mental models and expanded ability to satisfy the implicit and explicit goals of the group" (p. 48). Thereby, team learning products are defined as results of team learning activities.

The link between team learning activities and the cognitive team learning product of TMM is further explained by the team learning model of Van den Bossche et al. (2006, 2011). According to their model, shared mental representations, as captured by the construct of TMM, are built through sociocognitive processes in the team that aim at building a shared understanding of key concepts in the team's work environment. These sociocognitive processes are described as team members' interaction activities of negotiating meaning. In particular, these are team learning activities of knowledge sharing and mutually elaborating on that shared knowledge to reach an understanding about key concepts in the work environment that all team members agree upon (Van den Bossche et al., 2006, 2011). Thus, the shared knowledge that comprises TMM is built through team learning activities. In accordance with their model, Van den Bossche et al. (2006, 2011) found that team learning activities are positively related to shared cognition and TMM. The positive link between team learning activities and TMM is further supported by various authors stating that shared team-level knowledge is built through team learning activities (Ensley & Pearce, 2001; Langan-Fox, 2003; Mohammed & Dumville, 2001; Mohammed et al., 2010; Rico, Sanchez-Manzanares, Gil, & Gibson, 2008; Rouwette & Vennix, 2008).

Team learning activities are also positively related to the behavioral team learning product of team performance. According to Van Engen and Van Woerkom (2010), the collective level of competence a team brings into its performance is fueled by the shared experience of team learning activities. They argue that by engaging in team learning activities, like team reflection on task related problems, the team achieves the competence to adapt to changing circumstances, improve work routines, and solve new problems. Especially if teams

are faced with complex tasks, involving unpredictable change and uncertainty, the team depends on team learning activities in order to make sense of the work environment, understand customers, and coordinate actions effectively (Edmondson, 1999). As a consequence, teams that engage in team learning activities are likely to achieve better results (Kozlowski & Ilgen, 2006). In accordance with this assumption, the positive link between team learning activities and performance has been demonstrated in several empirical studies (e. g. De Dreu, 2007; Edmondson, 1999; Ensley & Pearce, 2001; Van der Vegt & Bunderson, 2005; Van Engen & Van Woerkom, 2010; Van Woerkom & Croon, 2009; Van Woerkom & Van Engen, 2009; Veestraeten, Kyndt, & Dochy, 2014; Zellmer-Bruhn & Gibson, 2006) and is also incorporate in contemporary theories and models of team learning (Decuyper et al., 2010; Knapp, 2010; Van den Bossche et al., 2006, 2011).

The team learning products of TMM and team performance are also assumed to be positively related. Notably, the construct of TMM has been proposed to be a major exploratory mechanism of team performance, explaining how members of successful teams interact (Cannon-Bowers & Salas, 1990; 2001). Overall, TMM is proposed to drive team performance by supporting effective and efficient coordination and fluent communication among team members (Cannon-Bowers et al., 1993; Klimoski & Mohammed, 994; Levesque et al., 2001). Santos, Uitdewilligen, and Passos (2015) describe three ways how TMM may foster team performance through enhancing coordination and communication in the team. Firstly (1), TMM enables implicit coordination (Cannon-Bowers & Salas, 1990; DeChurch & Mesmer-Magnus, 2010; Mohammed et al., 2010). Implicit coordination comprises the two basic components of *anticipation* of demands of the task and the actions and needs of team colleagues without being directly notified about those and, consequently, *dynamic adjustment* of team members' actions on basis of that anticipation to mutually adapt their behavior to the given circumstances (Rico et al., 2008). Sharing similar TMMs about the team and the task enables the team to successfully apply implicit coordination. As they hold team and task related TMMs, team members' individual anticipations and dynamic adjustments converge and, hence, team members interpret the task environment as well as changes in the task environment in compatible ways (Cannon-Bowers et al., 1993; Rico et al., 2008). Hence, by means of TMMs, anticipations and dynamic adjustments of different team members may become compatible and adaptive without explicit communication and coordination. This empowers the team to perform faster and more fluent (Rico et al., 2008).

Secondly (2), given shared TMM knowledge about the team and the task, team members share compatible representations about how the team functions, about the goals and

deadlines that have to be met, and about the pursued strategies for goal achievement (Mohammed et al, 2010; Mohammed & Nadkarni, 2014). Sharing this TMM knowledge, team members can align their work and team processes towards common goals and pursue common strategies to achieve those goals. As a consequence, coordination of work activities as well as adaptation to task demands is improved, leading to better decision making and team performance (Cannon-Bowers et al., 1993; Mohammed et al., 2010).

Thirdly (3), TMM fosters effective and efficient verbal communication in the team by enabling team members to quickly interpret suggestions made by each other, to discuss information and strategies that are relevant with respect to the common tasks and goals, and to provide each other with constructive feedback at the right point in time (Tindale et al., 2008). Overall, this fosters fluent cooperation and coordination leading to improved team performance.

In support for these arguments, the positive link between TMM and team performance has been demonstrated in numerous studies (e. g. Mohammed, Hamilton, Tesler, Mancuso, & McNeese, 2015; Kellermanns, Floyd, Pearson, & Spencer, 2008; Mathieu, Rapp, Maynard, & Mangos, 2010; Santos et al., 2015; Van den Bossche et al., 2011). In addition, DeChurch and Mesmer-Magnus (2010) confirmed this positive link in a meta-analysis.

### 2.3.2. The links between antecedents of team learning, team learning activities, and team learning products

#### 2.3.2.1. The interpersonal context as an antecedent of team learning activities

Theories of dialogic development in authentic work contexts suggest that crucial antecedents of team learning activities are located within the social context of the team (Garavan, McGuire, & Lee, 2015). Accordingly, contemporary theoretical models (Decuyper et al., 2010; Knapp, 2010; Van den Bossche et al., 2006) as well as empirical studies (Edmondson, 1999; Van den Bossche et al., 2006; Raes et al., 2015; Boon et al., 2013) have identified the interpersonal context, or more precisely, shared beliefs about the interpersonal context to be important drivers of team learning activities. In this thesis, the focus lies upon the three distinct interpersonal context beliefs: (1) Safe team climate, (2) task interdependence, and (3) team expert roles.

(1) Assuming that team learning activities are impeded by interpersonally threatening issues (Argyris & Schön, 1978), a safe team climate is important for team learning activities such as discussing errors, knowledge sharing, or team reflexivity to occur as it alleviates the fear of potential dangers stemming from the social character of these activities, like, for example, embarrassment or rejection after speaking up (Bauer & Mulder, 2011; Boon et al., 2013;

Edmondson, 1999; Decuyper et al., 2010; Van den Bossche et al., 2006). This argument is reinforced by several empirical studies that found support for a positive link between a safe team climate and social learning activities (Bauer & Mulder, 2011; Leicher & Mulder, 2016; Leicher, Mulder, & Bauer, 2013) as well as team learning activities (Boon et al., 2013; Edmondson, 1999; Raes et al., 2015; Van den Bossche et al., 2006).

(2) Runhaar, Brinke, Kuijpers, Wesselink, and Mulder (2014) give two reasons why team learning activities are likely to benefit from task interdependence. Firstly, task interdependence increases interaction among team members, which is a prerequisite of team learning activities. Only by means of interaction team members can exchange knowledge and ideas, do team reflection and create shared knowledge which then may be stored and retrieved. Secondly, task interdependence influences the quality of interaction. Given high task interdependence, team members are responsible for each other's task performance (Van den Bossche et al., 2006), which motivates them to help each other when they are confronted with problems. As a consequence, more team learning activities may be applied. Accordingly, in an experimental study by Wageman (1995), it was found that in case of task interdependence the quality of group processes increased and teams showed significantly more team learning activities. The positive link between task interdependence and team learning activities is also supported by several other empirical studies (Edmondson, 2002; Van den Bossche et al., 2006; Van Woerkom, 2011).

(3) In contrast to these positive effects of safe team climate and task interdependence on team learning activities, the interpersonal context belief of team expert roles may undermine the communication between team members and, hence, negatively affect team learning activities. It is often supposed that team expert roles may support teamwork outcomes if team members are pooling their different knowledge and viewpoints together, thereby arriving at a more comprehensive picture of reality and better decisions (Argote et al, 2001; Van der Vegt & Bunderson, 2005). This advantage was found to be present in experimental studies by Stasser et al. (1995) as well as Stewart and Stasser (1995). However, expert knowledge was designed to be rather simple in these studies, so that group members could easily understand each other's expert knowledge and its relevance for the common task. The experimental situation generated in these studies is crucially different from real life work situations in complex decision-making teams, where individuals' expert knowledge is complex and its relevance for the common task is ambiguous. Another experimental study investigating the effects of team expert roles on team learning was conducted by Ellis et al. (2003). Thereby, individual team members' expert knowledge was designed to be more complex so that its content and

relevance for the common task was ambiguous to other team members not sharing the same expert knowledge. Given these circumstances, a different picture revealed. Results showed moderate team expert roles, with pairs of team members sharing the same expert knowledge, to be more beneficial for team learning than strong or no team expert roles. Accordingly, detrimental effects of strong expertise diversity on team learning activities were found in field studies investigating organizational complex decision-making teams (Bunderson & Sutcliffe, 2002; Van der Vegt & Bunderson, 2005). Investigating multidisciplinary project teams, Van der Vegt and Bunderson (2005) found that team learning activities were only supported by a moderate amount of expertise diversity, whereas strong and weak expertise diversity hindered team learning activities. In a study with management teams, Bunderson & Sutcliffe (2002) found that strong team expert roles, as manifested in a clear distribution of unique functional expertise among team members (dominant function diversity), negatively affected information sharing in the team. In addition, Kotlarsky, van den Hooff, and Houtman (2015) found that the specialization of team members in different knowledge domains hampers the development of transactive memory systems, as team communication is negatively affected by syntactic knowledge boundaries. Results of these studies can be explained by expectancy theory (Vroom, 1964), as adapted for the team context by Bunderson and Sutcliffe (2002). If individual expert knowledge is complex and strong expert roles are perceived, team members may fail to speak the same language and to communicate at the same level. Then, according to expectancy theory, people do not expect their knowledge to be relevant or understandable for team colleagues. As a consequence, team members lack the motivation to perform team learning activities like knowledge sharing or team reflection. Thus, strong team expert roles may negatively affect intra-team communication and, hence, team learning activities, if individual expert knowledge is complex and its relevance for the common goal is ambiguous. Thus, in contrast to safe team climate and task interdependence, the interpersonal context belief of team expert roles may have rather detrimental effects on team learning activities in complex decision-making teams.

#### 2.3.2.2. Transformational leadership as an antecedent of team learning

Transformational leadership is a fruitful approach to support innovation in organizations (Hüttermann & Boerner, 2011; Sarros, Cooper, & Santora, 2008). According to transformational leadership theory, the transformational leader fosters innovation by communicating an inspiring vision, serving as a role model, intellectually stimulating followers to question assumptions and to think “out of the box”, and by an individualized consideration of backgrounds, perspectives, problems, and needs of team members (e.g. Bass

1985; 2000; Bass & Riggio, 2006; Jung, Chow, & Wu, 2003; Waldmann & Bass, 1991). This happens particularly in the context of work teams (Eisenbeiss et al., 2008; Waldmann & Bass, 1991). Thus, transformational leadership should also foster the behavioral team learning product of team innovativeness. There are two explanations why transformational leadership may foster team innovativeness.

Firstly, transformational leadership may enhance team innovativeness through affecting team members' intrinsic motivation (Jung et al., 2003). Shamir, House, and Arthur (1993) propose that transformational leaders affect motivational mechanisms by activating their followers' self-concepts. Accordingly, charismatic leaders "increase the intrinsic value of efforts and goals by linking them to valued aspects of the follower's self concept" (Shamir et al., 1993, p. 584). For example, a transformational leader may increase the intrinsic value that team members associate with goal accomplishment by articulating an inspiring vision that presents goals in terms of values that are positively linked to followers' self-concepts (Shamir et al., 1993). In support of this theory, Wang and Gagné (2013) found a positive relation between transformational leadership and intrinsic motivation of followers. Team members' intrinsic motivation takes a key role in Amabile's (1988) model of small group creativity and organizational innovation, for intrinsic "task motivation makes the difference between what an individual *can* do and what one *will* do" (Amabile, 1988, p. 133). Intrinsic motivation is required for team members to engage in the process of generating and realizing ideas (Amabile, 1988), which is essential for team innovativeness (Van Woerkom & Croon, 2009; West & Farr, 1990). Thus, by fostering intrinsic motivation, transformational leadership may lead to more team innovativeness (Jung et al., 2003).

Secondly, transformational leaders may also directly foster the generation and realization of ideas. This may be achieved by intellectual stimulation (Bass & Riggio, 2006). Encouraging followers to think "out of the box", to question existent assumption, to take another perspective, and to approach work situations in new ways, "new ideas and creative problem solutions are solicited from followers" (Bass & Riggio, 2006, p. 7). Consequently, this leads to more team innovativeness (Jung et al., 2003). Another way how transformational leadership may directly influence team innovativeness is by inspirational motivation. Providing an inspiring vision of innovation possibilities, transformational leaders may move groups into new directions (Waldmann & Bass, 1991). In addition, charismatic role modeling of innovative behavior may encourage followers to emulate the transformational leader in performing innovative behavior (Bass & Riggio, 2006; Jung et al., 2003). Consequently, team innovativeness should be enhanced. Thus, theoretical considerations propose that there is a

positive relation between transformational leadership and team innovativeness. Accordingly, a positive relation between transformational leadership and team innovativeness was found in empirical studies (e.g. Boerner, Eisenbeiss, & Griesser, 2007; Reuvers, Van Engen, Vinkenburg, & Wilson-Evered, 2008). Rosing et al. (2011) confirmed this relation in a meta-analysis.

Transformational leadership is also assumed to be positively related to the team learning activity of team reflection. According to transformational leadership theory, transformational leaders may support team reflection by (1) intellectually stimulating followers to question presuppositions and to take another perspective, (2) creating a shared vision that emphasizes a critical and reflective attitude towards work issues, and (3) applying charismatic role modeling of this critical and reflective attitude to reinforce that vision (Bass, 1985; 2000; Bass & Riggio, 2006). As followers identify with transformational leaders and want to emulate them (Bass & Riggio, 2006), role modeling of a critical and reflective attitude towards task related issues should trigger team reflection among followers. Accordingly, initial empirical evidence supports a positive relation between transformational leadership and team reflection (Bucic et al., 2010; Raes et al., 2013; Schippers et al., 2008).

The relations between team learning activities, team learning products, and antecedents of team learning, as identified so far, are summed up in the initial theoretical model depicted in Figure 2. This theoretical model is initial since the relations between team learning activities, team learning products, and antecedents of team learning will be refined in the research models developed in section 3. The model serves as a starting point for the identification of gaps in current research and theorizing. The research questions of this thesis are derived from the identified research gaps.

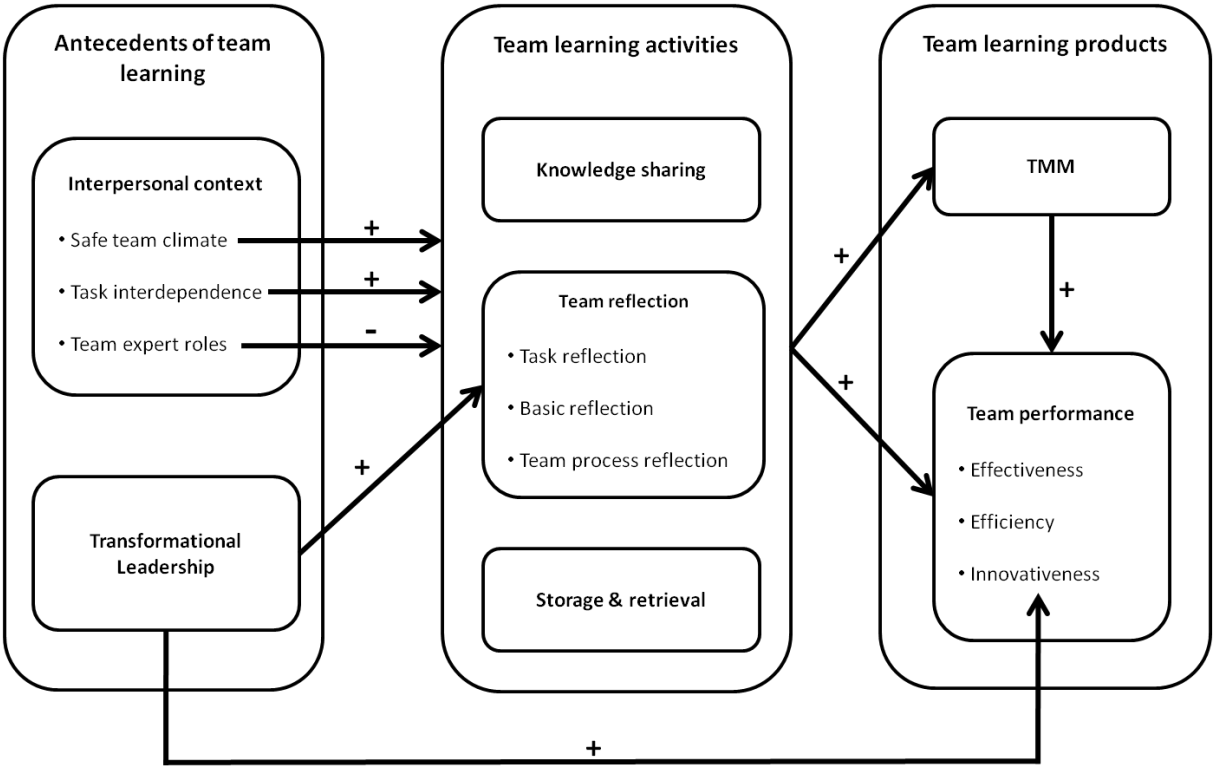


*Figure 2.* Initial theoretical model of the relations between team learning activities, team learning products, and antecedents of team learning. Arrows beginning or ending at the frame of a box indicate that a relation is assumed with respect to all constructs inside the box.

## 2.4. Research gaps and research questions

The first research gap derived from the current state of theorizing and research summed up in the initial theoretical model addresses the relations between interpersonal context beliefs and team learning activities. Even though it is acknowledged in current studies on the relationships between interpersonal context beliefs and team learning activities that team learning activities consist of distinct group-level activities, such as knowledge sharing, co-construction, or constructive conflict, in these studies, team learning activities are mainly measured unidimensionally (e.g. Boon et al., 2013; Edmondson, 1999; Raes et al., 2015; Van den Bossche et al., 2006; Van der Vegt & Bunderson, 2005). As a consequence, relations have mainly been investigated with respect to overarching constructs representing various team learning activities with one unidimensional measure. This is mirrored by the initial theoretical model, as arrows go from interpersonal context beliefs to the overarching category of team learning activities. Current theories and empirical studies do not allow for more detailed predictions with respect to single team learning activities. By not measuring distinct team learning activities separately, existent studies have been unable to clarify how different interpersonal context beliefs are

related to distinct team learning activities. In addition, one cannot rule out the possibility that the relationships identified bear upon some team learning activities but not upon others, since distinct constructs are measured with one unidimensional measure. As there is widespread agreement that team learning processes consist of different kinds of team learning activities (e.g. Decuyper et al., 2010; Knapp, 2010; Savelsbergh et al., 2009), the relations between interpersonal context beliefs and team learning activities need to be investigated in greater detail. The following Research Question arises.

**Research Question 1:** *What beliefs about the team's interpersonal context are related to which team learning activity?*

Furthermore, the antecedent of team expert roles has mainly been investigated in terms of objectively identifiable expert roles, for example, in the research on expertise diversity (e.g. Bunderson & Sutcliffe, 2002; Van der Vegt & Bunderson, 2005). The subjective perception of team expert roles as a part of the team's interpersonal context has been neglected in theorizing and research on the antecedents of team learning activities.

The second research gap identified addresses the relation between transformational leadership and team innovativeness. Despite empirical studies reveal the tendency of a positive relation between transformational leadership and team innovativeness (Rosing et al., 2001), in some studies no direct relation has been found (e.g. Eisenbeiss et al, 2008; Nijstad et al., 2014). Such inconsistent results have raised a call for studies investigating the mechanisms that link transformational leadership and team innovativeness (Hüttermann & Boerner, 2011; Rosing et al., 2011). Models by West and Anderson (1996), Nijstad et al. (2014), as well as Eisenbeiss et al. (2008) propose that transformational leadership may exert its effects on team innovativeness via mediating team processes. Accordingly, in a meta-analysis by Hülsheger, Anderson, and Salgado (2009), team process variables turned out to be the strongest team-level predictors of team innovativeness. Considering the initial theoretical model, it is derived that the team learning activity of team reflection plays a key role in the mediation between transformational leadership and team innovativeness. There are two links in the model that support this assumption. Firstly, transformational leadership theory proposes a particularly strong link between transformational leadership and team reflection, as transformational leaders may foster team reflection through creating a shared vision, through intellectually stimulating their followers, and by applying charismatic role modeling behavior (Bass, 1985; 2000; Bass & Riggio, 2006, see 2.3.2.2.). This link is also supported by initial empirical evidence (Bucic et al., 2010; Schippers et al., 2008). Secondly, team learning processes,

which include team reflection, are assumed to be positively related to team performance (see 2.3.1.), which includes team innovativeness. In particular, team reflection "has been shown to be an important predictor of team outcomes, notably innovation" (Schippers, West, & Dawson, 2015, p. 769). Accordingly, West (1996, 2000) theorizes that through team reflection the intention for team innovativeness is formed and the potential for carrying out associated actions and adaptations is built up. Though implications derived from transformational leadership theory, initial research on the link between transformational leadership and team reflection, as well as theory and research on the link between team reflection and team innovativeness are all speaking in favor of team reflection mediating between transformational leadership and team innovativeness, this mediation has not been tested yet in empirical studies. Taking up the call for studies investigating the linking mechanisms between transformational leadership and team innovativeness (Hüttermann & Boerner, 2011; Rosing et al., 2011) the following Research Question is investigated.

**Research Question 2:** *What is the mediating role of team reflection in the relation between transformational leadership and team innovativeness?*

Furthermore, recent study results suggest the relation between team reflection and team innovativeness to be affected by moderating variables (Dayan & Basarir, 2010; Schippers et al., 2015). Therefore, the mediating role of team reflection between transformational leadership and team innovativeness may also depend on moderating variables. Contributing to this newly emerging insight concerning combinations of factors supporting innovativeness in teams, it is further investigated whether the mediation through team reflection is moderated by (1) transformational leadership and (2) safe team climate. As further outlined below (see 3.2.2.1.), it is argued that transformational leadership may support the investigated mediation by empowering followers to implement innovative ideas resulting from team reflection. With respect to safe team climate, it is argued that a safe team climate and team reflection need to coincide to bring about team innovativeness, whereas a safe team climate is providing the social support necessary to implement innovative ideas resulting from team reflection (see 3.2.2.2.).

The third research gap identified addresses the relations between team learning activities and the team learning product of TMM-TM. Little is known about how TMM knowledge is built and how team learning activities contribute to the formation of TMM (DeChurch & Mesmer-Magnus, 2010). Existent studies have only begun to unravel the complex relations between team learning activities and TMM (Van den Bossche et al., 2011).

To date the field still remains "an area of opportunity for team cognition researchers" (Wildman et al., 2012, p. 108). In a study with dyads of college students working on a learning task, Jeong and Chi (2007) found that the degree of collaborative interaction predicted the amount of commonly held knowledge in the dyad with respect to the learned material. However, not investigating the quality of the collaborative interaction in detail, their study does not answer the question which team learning activities contributed to the creation of shared knowledge. Few studies have investigated the link between team learning activities and TMM directly. Van den Bossche et al. (2011) found the team learning activity of constructive conflict to be positively related to TMM knowledge concerning the team's task. Likewise, Ensley and Pearce (2001) found a positive relation between cognitive conflicts and shared strategic cognition in the team. In an experimental study, Gurtner, Tschan, Semmer, and Nägele (2007) found that groups that received guided reflexivity interventions developed more common knowledge with respect to team interaction. These studies give initial insight into the relevance of team learning activities for the emergence of TMM knowledge with respect to the team's task, strategy, and interaction. However, to date there are no studies investigating the relations between team learning activities and TMM knowledge about the team members themselves, in particular about their knowledge, skills, and work related attitudes, or stated briefly, about their vocational competencies (TMM-TM). Thus, to date it is an open question how team learning activities are related to TMM-TM with respect to team members' occupational, social, meta, and personal vocational competencies.

**Research Question 3:** *How are team learning activities related to TMM-TM (occupational, social, meta, personal)?*

Though it has to be acknowledged that there are studies investigating the relations between team learning activities and TMS (e.g. Dayan & Basarir, 2010; Oertel & Antoni, 2015), which theoretically encompasses TMM-TM (see 2.1.2.1.), this research is not sufficient to answer Research Question 3 for three reasons. (1) The concept of vocational competence used in the definition of TMM-TM is broader than the concept of "a shared understanding of who knows what" (Oertel & Antoni, 2015, p. 726) that is applied in the context of TMS. Whereas TMM-TM refers to shared knowledge about the occupational, social, meta, and personal competencies of team members, the TMS literature mainly refers to shared knowledge about team members' occupational competencies only (e. g. Austin, 2003; Lewis, 2003; Wegner, 1986). Consequently, studies investigating TMS do not capture the full concept of TMM-TM as conceptualized in this thesis.

(2) The construct of TMS also encompasses dimensions that are distinct from TMM-TM. For example, a TMS is also characterized by the degree of specialization of team members within different domains of occupational competence as well as by team members' metacognitive beliefs about the reliability of the occupational competencies of their team colleagues (Lewis, 2003). Thus, measures of TMS seek to incorporate various dimensions that are not exclusively focused on the aspect of shared knowledge structures (e. g. Austin, 2003; Lewis, 2003; Pearsall et al., 2010).

(3) The measurement methods applied in TMS research are not adequate for measuring TMM. The measurement of TMM requires that shared knowledge structures are measured with respect to their content and structure (Mohammed et al., 2010). Measurement of TMS is not conceptualized to fulfill these criteria. For example, TMS field research is mainly conducted with Likert-type scale questionnaires, which are inappropriate for the measurement of TMM as they do not measure TMM structure (Mohammed et al., 2010).

The fourth research gap addressed concerns the relation between TMM-TM and team performance. There is a relatively solid research base speaking in favor of a positive relation between TMM and team performance (see 2.3.1.). However, this positive link mostly bears upon studies investigating task related TMMs (e.g. Kellermanns et al., 2008; Mathieu et al., 2010; Van den Bossche et al., 2011), TMMs with respect to team interaction (e.g. Ellis, 2006; Gurtner et al., 2007; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Rentsch & Klimoski, 2001), or both (e.g. Lim & Klein, 2006; Santos et al., 2015). However, to date no studies have been conducted to investigate how TMMs with respect to vocational competencies of team members are related to team performance. Though given sound empirical evidence that team performance is fostered by TMS (DeChurch & Mesmer-Magnus, 2010; Kozlowski & Ilgen, 2006; Oertel & Antoni, 2015), which conceptually encompasses TMM-TM (see 2.1.2.1.), it has not yet been tested directly whether TMM-TM by itself supports team performance. Moreover, within the framework of transactive memory, TMM-TM has been conceptualized as shared knowledge with respect to team members' occupational competencies (see Wegner, 1986, 1995). Thus, TMS-research cannot clarify the question how TMM-TMs with respect social, meta, and personal competencies are related to team performance. The question arises, what kind of TMM-TM knowledge (occupational, meta, social, personal) needs to be shared in the team to support team performance.

**Research Question 4:** *How is TMM-TM (occupational, social, meta, personal) related to team performance?*

In contrast to the extensive theorizing and research in the fields of TMM and TMS, there is a lack of boundary breaking theorizing and research elaborating on the conceptual overlap of these two constructs. Thus, to date it remains largely uncharted which kinds of information about team member competencies are encoded in the TMM-TM, how it affects team performance, and which team learning activities make it emerge. Due to the current paucity of theorizing concerning TMM about team members' occupational, social, meta, and personal vocational competencies, Research Questions 3 and 4 are acknowledged to have partly explorative character.

# 3. Elaborating the complex relations between activities, products, and antecedents of team learning

To answer the formulated Research Questions, testable hypotheses need to be identified. This requires an in depth consideration of the complex relations between activities, products, and antecedents of team learning. Firstly, the relations between interpersonal context variables and distinct team learning activities are considered (see 3.1.; Research Question 1). Secondly, the mediating role of team reflection between transformational leadership and team innovativeness is focused (see 3.2.; Research Question 2). Safe team climate and transformational leadership are considered as potential moderators of the mediation (see 3.2.2.). Thirdly, the relations between team learning activities and TMM-TM (see 3.3.1.; Research Question 3), as well as between TMM-TM and team performance (see 3.3.2.; Research Question 4) are elaborated. Hypotheses are derived.

## 3.1. The relations between interpersonal context variables and distinct team learning activities

### 3.1.1. Safe team climate

A safe team climate is considered to foster team learning activities by alleviating the fear of potential dangers stemming from the social character of these activities, like embarrassment or rejection after speaking up (Bauer & Mulder, 2011; Boon et al., 2013; Edmondson, 1999; Decuyper et al., 2010; Van den Bossche et al., 2006; see 2.3.2.1.). This assumption is supported by several empirical studies. In a study involving different kinds of work teams, Edmondson (1999) found a positive relation between psychological safety and team learning activities. Investigating student teams, Van den Bossche et al. (2006) found a positive relation between psychological safety and team learning activities. Boon et al. (2013) and Raes et al. (2015) replicated this finding in the context of work teams. In a field study on learning from errors at

work in the domain of nursing, Bauer and Mulder (2011) found an indirect effect of the perception of a safe team climate on the engagement in social learning activities. This finding has been replicated by Leicher et al. (2013) in the domain of elder care nursing, and by Leicher and Mulder (2016) in the domain of retail banking. However, as already highlighted (see 2.4.), in all of these studies several distinct team learning activities were measured with one unidimensional scale, thereby neglecting the possibility of differential relations between a safe team climate and different team learning activities. The question arises, whether the positive relation between a safe team climate and team learning activities that was found in these studies, is also given with respect to differential relations between a safe team climate and several distinct team learning activities. Assuming that a safe team climate fosters team learning activities by reducing team members' social fears associated with these activities, it follows that only those team learning activities can be enhanced by a safe team climate that might be perceived as self-threatening in social situations. In principle, this applies to all team learning activities that are performed in direct social interaction. Hence, with respect to the team learning activities focused in this thesis, a safe team climate is expected to be positively related to knowledge sharing, task reflection, basic reflection, and team process reflection, as these team learning activities are performed in direct social interaction. The fifth team learning activity investigated, storage and retrieval by use of material repositories, is not primarily performed in direct social interaction, but rather through interaction with artifacts, e.g. team documents or computer databases. Therefore, a safe team climate is not expected to be significantly related to storage and retrieval. The outlined considerations yield the following hypotheses.

Hypothesis 1: A safe team climate is positively related to knowledge sharing.

Hypothesis 2: A safe team climate is positively related to task reflection.

Hypothesis 3: A safe team climate is positively related to basic reflection.

Hypothesis 4: A safe team climate is positively related to team process reflection.

### 3.1.2. Task interdependence

As in case of safe team climate, theoretical considerations (Runhaar et al., 2014) as well as empirical studies (Edmondson, 2002; Van den Bossche et al., 2006; Van Woerkom, 2011; Wageman, 1995) are speaking in favor of a positive link between task interdependence and team learning activities (see 2.3.2.1.). However, also as in case of safe team climate, empirical

studies investigating this issue are not measuring distinct team learning activities separately (see Van den Bossche et al., 2006; Van Woerkom, 2011; Wageman, 1995). Therefore, these studies are prone to the limitation highlighted before (see 2.4.). To gain a more detailed insight, differential relations between task interdependence and distinct team learning activities need to be considered.

It is proposed that knowledge sharing is more likely performed in case of high task interdependence. If team members believe that they can only successfully accomplish their work tasks if their team colleagues do so, as it is characteristic for high task interdependence (Decuyper et al., 2010), they should be motivated to help each other by sharing their knowledge (Runhaar et al., 2014). In support of this argument, Van den Bossche et al. (2006) found a positive relation between interdependence (task and goal) and team learning activities, as represented by a unidimensional measure that, amongst others, included the notion of knowledge sharing. Likewise, Van Woerkom (2011) found a positive relation between task interdependence and team learning activities, as represented by a unidimensional measure including, amongst others, the notion of knowledge sharing. However, studies directly investigating the relation between task interdependence and knowledge sharing are currently lacking. Based on the outlined theoretical argument and the given empirical evidence, a positive relation between task interdependence and knowledge sharing is expected.

Hypothesis 5: Task interdependence is positively related to knowledge sharing.

Team reflection might benefit from task interdependence as well. In case of high task interdependence team members' tasks are deeply intertwined. Consequently, their work is aligned towards a common goal and they are encouraged to work together cooperatively and to develop a common interest for each other's work activities (Tjosvold, Tang & West, 2004). This is an important antecedent of team reflection with respect to tasks, work related basic assumptions, and team interaction processes, as it defines the common ground on which to reflect on. Given low task interdependence, a clear common task, goal, and team interaction process of cooperatively working towards a common goal might be lacking. Thus, work related issues to reflect on as a team might be lacking as well. In contrast, given high task interdependence with team members' tasks being deeply intertwined, a distinct common interest with respect to each other's work activities is more likely to emerge. Consequently, team members should come up with topics of common interest relevant for team reflection with respect to tasks, work related basic assumptions, and team interaction processes. For example, if team members' tasks are intertwined in a way that creates the need to exchange information, to

solve problems in cooperation, and to mutually coordinate efforts in reaching a common goal, topics of common interest for team reflection are clearly given. Thus, task interdependence is proposed to foster team reflection. Supporting this argument, Tjosvold et al. (2004) found a positive relation between goal interdependence and team reflection. Furthermore, Van den Bossche et al. (2006) found a positive relation between interdependence (task and goal) and team learning activities, as represented by a unidimensional measure including, amongst others, the notion of team reflection (co-construction, constructive conflict). Likewise, Van Woerkom (2011) found a positive relation between task interdependence and team learning activities, as represented by a unidimensional measure including, amongst others, the notion of team reflection. However, studies directly investigating the relation between task interdependence and the distinct team reflection activities of task reflection, basic reflection, and team process reflection are currently lacking. Considering the argument outlined above as well as the given empirical studies, positive relations between task interdependence and all three investigated team reflection activities are expected.

Hypothesis 6: Task interdependence is positively related to task reflection.

Hypothesis 7: Task interdependence is positively related to basic reflection.

Hypothesis 8: Task interdependence is positively related to team process reflection.

Furthermore, task interdependence is proposed to be positively related to storage and retrieval by use of material repositories. The development of a common interest for each other's work activities due to high task interdependence should enhance the use of common artifacts for the codification and preservation of shared knowledge. If team members need to cooperate on a common task, they may utilize storage and retrieval to be on the same page with respect to their intertwined work activities. Thereby, material knowledge repositories might be used get a grasp of what everyone in the team is doing in performing on the common task. For example, next steps to be undertaken in task execution by each team member may be recorded in documents created by the team, which then guide team members' subsequent work activities while interdependently performing on the common task. Accordingly, Van Woerkom (2011) found a positive relation between task interdependence and team learning activities, as represented by a unidimensional measure including, amongst others, the notion of storage and retrieval by use of material repositories. However, studies directly investigating the relation between task interdependence and storage and retrieval by use of material repositories are currently lacking.

Considering the outlined argument together with the rather sparse current empirical evidence, task interdependence is hypothesized to be positively related to storage and retrieval.

Hypothesis 9: Task interdependence is positively related to storage and retrieval.

### 3.1.3. Team expert roles

Considering expectancy theory (Vroom, 1964; Bunderson & Sutcliffe, 2002; see 2.3.2.1.), certain team learning activities are proposed to be significantly hindered by team expert roles. This particularly applies with respect to knowledge sharing. In case of strong team expert roles, expectancy theory predicts that team members consider their expert knowledge to be too special to be relevant or understandable for team colleagues. Consequently, motivation to share knowledge will be undermined by team expert roles (Bunderson & Sutcliffe, 2002). Study results by Bunderson and Sutcliffe (2002) support this assumption.

Hypothesis 10: Team expert roles are negatively related to knowledge sharing.

Likewise, a negative relation between team expert roles and task reflection is expected. Perceiving strong team expert roles, team members might expect no gain from team reflection on problems they encounter during task execution, assuming their team colleagues, who they perceive as not sharing their specific expertise, lack the competence to work on the given problem (see 2.3.2.1.). Supporting this argument, Van der Vegt and Bunderson (2005) found that team learning activities, as represented by a unidimensional measure including, amongst others, the notion of task reflection, were hindered by strong expertise diversity. However, empirical studies directly investigating the relation between team expert roles and task reflection are currently lacking.

Hypothesis 11: Team expert roles are negatively related to task reflection.

In contrast, basic reflection is not assumed to be essentially affected by the phenomenon of expectancy as associated with team expert roles. Basic reflection does not focus on certain details of a specific task, but rather on comprehensive issues that relate to the team as a whole (e.g. team goals). As these issues are not exclusively connected to the knowledge of individual experts, motivation for basic reflection should not be hindered by team expert roles. Moreover, given the right circumstances, cooperation of different kinds of experts may stimulate team learning activities (Drach-Zahavy & Somech, 2001; Van der Vegt & Bunderson, 2005). Information and decision-making theories predict that expertise diversity leads to increased cognitive processing in the team (Cady & Valentine, 1999). As experts of

different fields substantially differ in their perspectives (Jackson, 1996), the presence of distinct team expert roles may trigger discussions about basic assumptions. Basic assumptions, like team goals or work methods, are the part of the foundation the team's work relies upon. As such they are not easily called into question (Høyrup, 2004). Different perspectives of experts in different fields may be helpful to take a step back from everyday work and reflect on these basic assumptions. However, to my knowledge, no empirical investigation of the relation between team expert roles and basic reflection has been conducted so far.

Hypothesis 12: Team expert roles are positively related to basic reflection.

As in case of basic reflection, it is not expected that team process reflection is affected by the phenomenon of expectancy. Team interaction processes do not refer to specific areas of individual expertise but relate to the interaction of the team as a whole. Therefore, team reflection on team interaction processes should not be undermined by the expectation that task-specific expert knowledge is not relevant or understandable for other team members. However, team expert roles might nevertheless affect team process reflection. In case of distinct team expert roles tasks and areas of responsibility are strictly divided among team members. This type of team structure determines, at least to a certain degree, the way how team members need to interact (e.g. whose work areas are connected, who needs to give information to whom, or who is responsible for which decision), so team members have less options in organizing their interaction (Drazin & Van de Ven, 1985). As a consequence, team reflection on team interaction processes may be undermined. For example, imagine a product development team in which there is one particular member who is responsible for the area of market research. In this case, specific information relevant for this area needs to be forwarded to that particular team member and in most cases it would be mistaken for the team to decide not to forward that information to this person but to another team member instead. Reflecting on the corresponding team interaction processes might appear pointless here, since the necessary flow of information is determined by the team member's expert role and, hence, can hardly be altered. Therefore, it is suggested that team expert roles reduce the team's latitude to alter team interaction processes by imposing a fixed structure with respect to the distribution of tasks and responsibilities. As a consequence, team reflection on team interaction processes may be hindered by team expert roles. However, studies investigating the relation between team expert roles and team process reflection are currently lacking.

Hypothesis 13: Team expert roles are negatively related to team process reflection.

Further, it is proposed that team expert roles and storage and retrieval are negatively related. Storage and retrieval using material repositories requires the identification of knowledge that is relevant for different team members and the codification of that knowledge in written language (Van Woerkom & Croon, 2009). Specialization of individual team members in distinct areas of expertise hinders the identification of common issues relevant for different team members and makes it difficult to settle on a common language for debating these issues (Bunderson & Sutcliffe, 2002). This may substantially exacerbate the selection of knowledge to store and retrieve at the team-level and also the codification of that knowledge in a way understandable for everyone in the team. Thus, storage and retrieval with material repositories may be utilized less in case of distinct team expert roles. However, to my knowledge, the relation between team expert roles and storage and retrieval has not been investigated yet in an empirical study.

Hypothesis 14: Team expert roles are negatively related to storage and retrieval.

The developed hypotheses concerning the differential relations between interpersonal context variables and team learning activities are summed up in Research Model 1, which is depicted in Figure 3. No arrow is drawn from safe team climate to storage and retrieval, as no significant relation is expected between these two variables (see 3.1.1.).

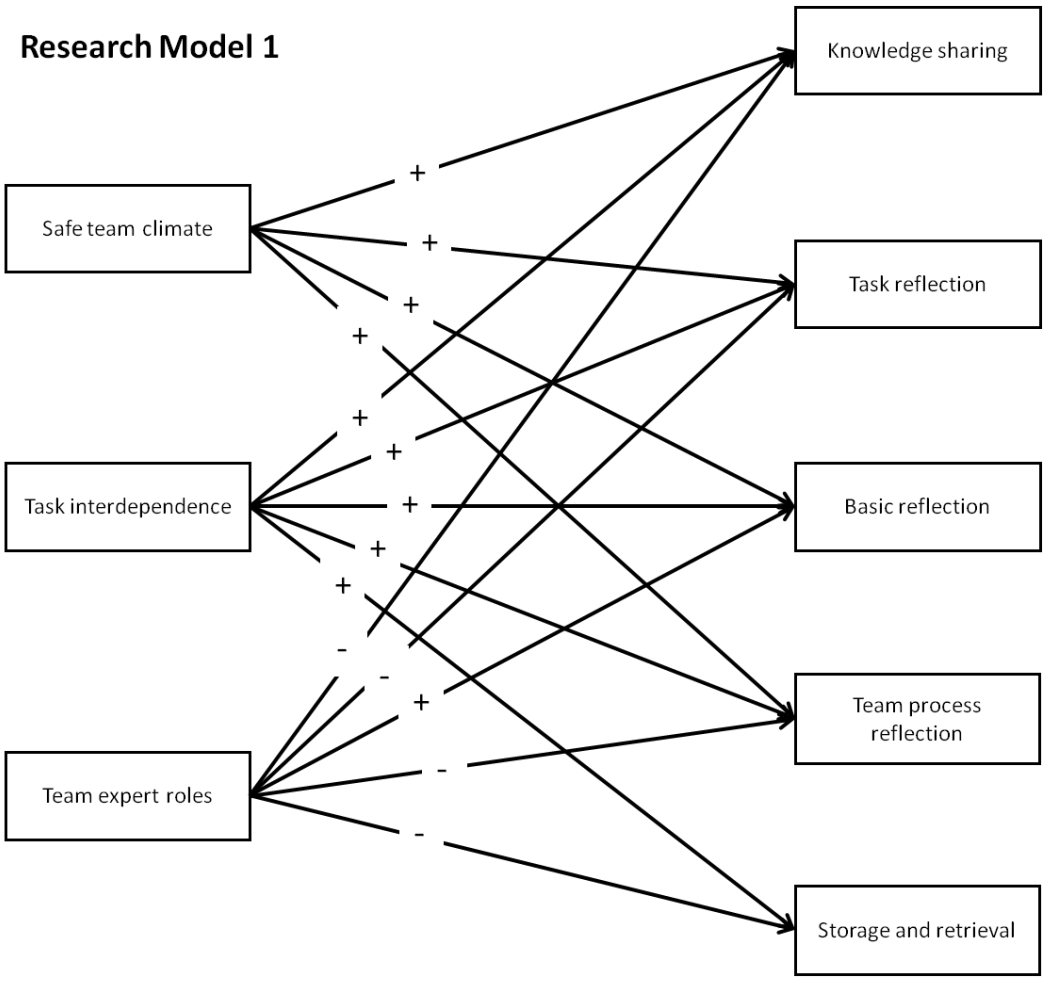


*Figure 3.* Research Model 1: Hypothesized differential relations between interpersonal context variables and team learning activities.

### 3.1.4. Control variables

Apart from the interpersonal context there are probably also other antecedents of team learning activities. Building on previous research and theorizing, two control variables are identified as potentially relevant in this respect: (1) Team size and (2) team tenure.

(1) Team size may have important effects on team learning activities (Ancona & Caldwell, 1992; Bunderson & Sutcliffe, 2002; Goodman, Ravlin, & Argote, 1986). Bunderson and Sutcliffe (2002) argue that in larger teams team members have fewer opportunities to directly interact with everyone in the team. Accordingly, they found a negative relation between team size and information sharing in the team. Thus, team size may negatively affect those team learning activities requiring direct interaction among team members. This applies to all team learning activities investigated in this thesis except for storage and retrieval, which is primarily performed through interaction with artefacts (see 2.1.1.3.).

(2) In addition, team tenure, which is to be understood as the current amount of time the team exists, may also affect team learning activities. Team tenure is taken as a rough estimate of a team's maturity since the development of maturity of teams is a prolonged temporal process (Hall, 2007). Sessa & London (2008b) argue that a team has to develop maturity, which means that it has to become a complex and integrated system, before its members are able to perform generative and transformative team learning. Generative learning occurs when the team acquires new knowledge and skills in order to change its goals, tasks, or work methods, whereas transformative learning occurs when the team is required to make major changes in its structure, tasks, or goals (Sessa & London, 2008b). The notion of generative and transformative team learning is reflected by the team learning activities of basic reflection and team process reflection, since the status quo with respect to goals, work methods, and team interaction processes is questioned when these team learning activities are applied. Therefore, team tenure is proposed to be positively related to basic reflection and team process reflection as it is assumed that teams need to develop maturity to perform these team learning activities. This assumption is supported by Raes et al. (2015), who found that team learning occurs more in later phases of group development.

## 3.2. Team reflection linking transformational leadership and team innovativeness

### 3.2.1. The mediating role of team reflection between transformational leadership and team innovativeness

It has been drawn out that transformational leadership may enhance team innovativeness and team reflection (see 2.3.2.2.). Moreover, team reflection is proposed to be a mediator of the effects of transformational leadership on team innovativeness (see 2.4., Research Question 2). To argue for this mediation, it has to be demonstrated that: (1) team reflection is positively related to team innovativeness and (2) transformational leadership is positively related to team reflection (see Hayes, 2013).

(1) Team innovativeness is the introduction and successful application of ideas, processes, products, and procedures that are new to the team (Van Woerkom & Croon, 2009; West & Farr, 1990). Team reflection may support team innovativeness by being a driving force in this process of introducing and applying ideas (West, 1996, 2000). When doing team reflection, team members generate and discuss different ideas concerning task related problems, basic assumptions, as well as team interaction processes and they also make decisions about whether and how to put these ideas into practice. Subsequent actions trigger further team reflection leading to an evaluation and refinement of the applied ideas. It results

from continuous cycles of reflection and action that innovative ideas are successfully introduced and put into practice (West, 1996, 2000). In support for this argument, sound empirical evidence demonstrates a positive link between team reflection and team innovativeness (e.g. Dayan & Basarir, 2010; Schippers et al., 2015; Tjosvold et al., 2004; Van Woerkom & Croon, 2009; for a review, see Widmann, Messmann, & Mulder, 2016). Thus, team reflection can be considered as an antecedent of team innovativeness.

(2) Transformational leadership is a promising approach to support team reflection and, subsequently, team innovativeness. According to transformational leadership theory, team reflection with respect to task related problems, basic assumptions, and team interaction processes is supported by transformational leaders through (1) intellectual stimulation of followers to question presuppositions and to take another perspective, through (2) creating a shared vision that emphasizes a critical and reflective attitude towards work issues, as well as through (3) applying charismatic role modeling of this attitude to reinforce that vision (e.g. Bass, 1985; 2000; Bass & Riggio, 2006, see 2.3.2.2.). To date, only a few studies have investigated the relation between transformational leadership and team reflection. These studies found support for a positive relation (Bucic et al., 2010; Raes et al., 2013; Schippers et al., 2008, see 2.3.2.2.).

Assuming that transformational leadership supports team reflection on task related problems, basic assumptions, and team interaction processes, and that team reflection regarding these issues in turn supports team innovativeness, team reflection activities may mediate the positive effects of transformational leadership on team innovativeness (Hülsheger et al., 2009; Schippers et al., 2008). Some initial empirical support for this mediation stems from studies that found evidence for a mediating effect of team reflection between transformational leadership and team performance (Hirst, Mann, Bain, Pirola-Merlo, & Richver, 2004; Schippers et al., 2008). However, these studies give no specific information with respect to team innovativeness. Further support comes from a study by Boerner et al. (2007), who questioned department leaders and team leaders in a field study. They found that transformational leadership enhances follower innovation by triggering controversial discussions of task related issues, which is very similar to team reflection. However, there are two limitations of this study that restrict its validity concerning the mediating role of team reflection between transformational leadership and team innovativeness. Firstly, the study was not conceptualized at the team-level and, therefore, no conclusions about activities and products of team learning can be derived. Secondly, measures of team processes where not collected from team members, but from team or department leaders. The validity of leader

ratings concerning team processes of their followers may be doubted given the large average number of 34 subordinates per leader in this study. However, considering the presented theoretical arguments together with the given initial empirical evidence, it is hypothesized that team reflection mediates the positive effects of transformational leadership on team innovativeness.

> Hypothesis 15: Team reflection mediates the positive relationship between transformational leadership and team innovativeness.

It is not considered reasonable to formulate distinct hypotheses with respect to the team reflection activities of task reflection, basic reflection, and team process reflection, since it is assumed that team innovativeness is fostered by all of these team reflection activities, and that transformational leadership fosters all of these team reflection activities.

### 3.2.2. Moderated mediation

#### 3.2.2.1. The moderating role of transformational leadership

But mediation might not be the complete story. It is proposed that transformational leadership not only affects team innovativeness through the mediation of team reflection, but also by moderating the link between team reflection and team innovativeness. In technical terms, this can be stated as transformational leadership being a moderator of its own indirect effect. This type of moderated mediation, where the independent variable moderates the link between the mediator and the dependent variable, has been applied in numerous studies (e.g. D'Lima, Pearson, & Kelley, 2012; Moneta, 2011) and is formally described in Hayes (2013).

Two theoretical arguments are speaking in favor of the proposed moderated mediation. The first argument is based on the concept of empowerment of followers, which is a fundamental part of transformational leadership (Bass & Riggio, 2006; Joo & Lim, 2013; Kark, Shamir, & Chen, 2003; Carless, Wearing, & Mann, 2000). Empowerment of followers involves that transformational leaders delegate important tasks and responsibilities to followers and that followers receive the trust and authority to make decisions and handle tasks their way (Bass & Riggio, 2006). This is a necessary requirement for team reflection to yield team innovativeness, as reflection at the workplace can only yield innovative outcomes if team members are empowered to incorporate ideas resulting from reflection into significant decision-making aiming at the adjustment and improvement of their work performance (Messmann & Mulder, 2015). Thus, empowerment should foster the link between team reflection and team innovativeness by enabling team members to implement innovative ideas

resulting from team reflection. A high amount of transformational leadership style ensures that team members are empowered to implement their collaborative ideas as the transformational leader provides them with the necessary authority, trust, and responsibility to make decisions and handle tasks their way. Thus, given a high amount of transformational leadership, innovative ideas resulting from team reflection may be more likely to be implemented than in teams with low levels of transformational leadership that lack the necessary empowerment to implement their ideas.

The second argument refers to charismatic role modeling behavior in transformational leadership, which is also called *idealized influence* (Bass & Avolio, 1994). A transformational leader's idealized influence may encourage followers to successfully realize innovative ideas resulting from team reflection. Bass and Riggio (2006, p.6) state that "leaders who have a great deal of idealized influence are willing to take risks and are consistent rather than arbitrary. They can be counted to do the right thing". By emulating the role model of a transformational leader who takes risk and is simultaneously embodying an ideal of "having extraordinary capabilities, persistence and determination" (Bass & Riggio, 2006, p.6), followers should be determined to take the risk of failure, which is inherent in the innovation process (Bowers & Khorakian, 2014), and to successfully put their ideas into practice. Therefore, through idealized influence, transformational leaders may encourage followers to successfully realize innovative ideas resulting from team reflection and, consequently, team reflection may be more likely to yield team innovativeness.

Following these arguments, it is proposed that transformational leadership fosters the process of putting innovative ideas resulting from team reflection on task related problems, basic assumptions, and team interaction processes into practice. Hence, it is assumed that the relation between team reflection and team innovativeness is moderated by transformational leadership. Accordingly, the mediating effect of team reflection in the relation between transformational leadership and team innovativeness should only be given, if a high amount of transformational leadership behavior is present in the team.

> Hypothesis 16: Transformational leadership moderates the mediating effect of team reflection in the relation between transformational leadership and team innovativeness; the mediation effect is positive at high levels of transformational leadership.

As in case of Hypothesis 15, it is not considered reasonable to formulate distinct hypotheses with respect to the team reflection activities of task reflection, basic reflection, and team

process reflection, since it is assumed that transformational leadership fosters the realization of innovative ideas resulting from all of these team reflection activities.

#### 3.2.2.2. The moderating role of safe team climate

Furthermore, a safe team climate may not only support team learning activities, it may also support team reflection to yield team innovativeness. Hence, a safe team climate is also proposed to be a moderator of the mediation of team reflection between transformational leadership and team innovativeness. The argument for this moderation starts from the premise that team innovativeness always implies that team members implement some kind of change in their work context (Schippers et al., 2015) and that there is no guarantee that this implementation will turn out a success. Thus, to achieve innovative outcomes, team members need to approve the risk of failure (Bowers & Khorakian, 2014). A safe team climate may enhance team member's readiness to take this risk because, given high levels of safe team climate, failure is not seen as something bad, but is rather appreciated as a learning opportunity (Bauer & Mulder, 2011). Thus, innovative ideas resulting from team reflection on task related problems, basic assumptions, and team interaction processes may be more likely to be implemented and, hence, to yield team innovativeness, if a high amount of safe team climate provides the social support necessary to approve the risk of failure (Agrell & Gustafson, 1996).

It also might be argued that a safe team climate by itself already promotes team innovativeness (see Burke, Stagl, Salas, Pierce, & Kendall, 2006). However, meta-analysis by Hülsheger et al. (2009) showed that the correlation between safe team climate and team innovation is weak and nongeneralizable. Therefore, it is proposed that safe team climate and team reflection need to coincide in order to promote team innovativeness, whereas team reflection is providing the team with innovative ideas and safe team climate provides the necessary social support to implement these ideas. Thus, the relation between team reflection and team innovativeness is assumed to be moderated by safe team climate. As in case of moderation by transformational leadership, it is proposed that a safe team climate fosters the process of putting innovative ideas, resulting from team reflection, into practice. Consequently, safe team climate is hypothesized to be a moderator of the mediating effect of team reflection between transformational leadership and team innovativeness.

> Hypothesis 17: Safe team climate moderates the mediating effect of team reflection in the relation between transformational leadership and team innovativeness; the mediation effect is positive at high levels of safe team climate.

As for Hypotheses 15 and 16, it is not considered reasonable to formulate distinct hypotheses with respect to the team reflection activities of task reflection, basic reflection, and team process reflection, since it is assumed that safe team climate fosters the realization of innovative ideas resulting from all of these team reflection activities. The developed hypotheses concerning mediation and moderated mediation are summed up in the Research Models 2, 3, and 4, which are depicted in Figure 4.

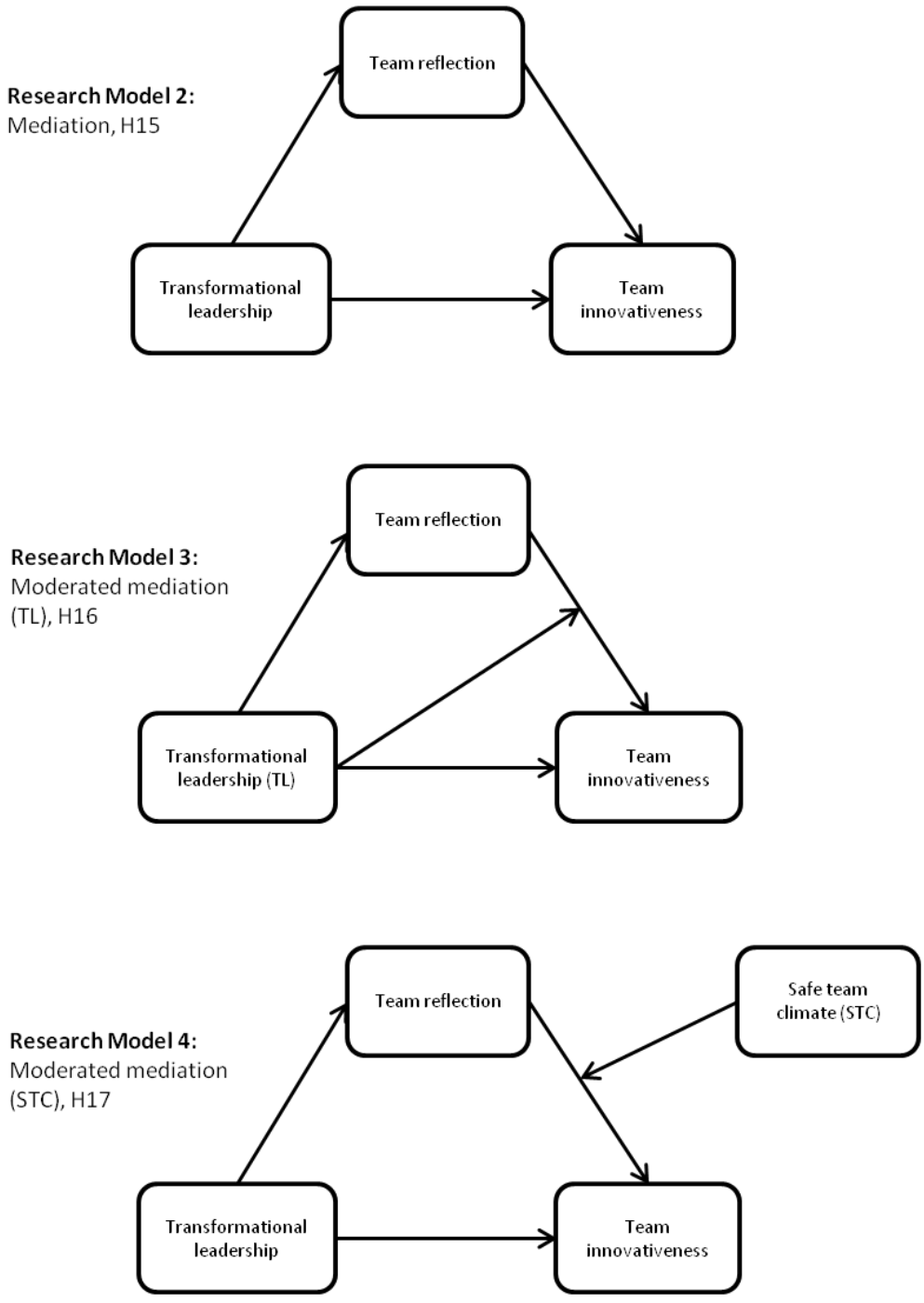


*Figure 4.* Research Models 2, 3, and 4: Hypotheses concerning mediation and moderated mediation of team reflection between transformational leadership and team innovativeness.

### 3.2.3. Control Variables

Building on previous research and theorizing, two control variables that are potentially relevant with respect to team innovativeness are identified: (1) Team size and (2) organizational type.

(1) Team size may affect team innovativeness because larger teams might benefit from a wider array of resources and perspectives for solving difficult tasks and, therefore, be more innovative (Hülsheger et al., 2009). Accordingly, in a meta-analysis by Hülsheger et al. (2009) team size was positively related to team innovativeness.

(2) Team innovativeness may also be affected by the organizational type as defined by the profit orientation of an organization. In this respect, profit and non-profit organizations are to be distinguished. Study results by Ruvio, Rosenblatt, and Hertz-Lazarowitz (2010) suggest that leaders in profit organizations put a stronger focus on flexibility and competitiveness than leaders in non-profit organizations. Highlighting flexibility and competitiveness probably also emphasizes a need for team innovativeness since innovation is crucial for maintaining flexibility and competitiveness (Tellis, Prabhu, & Chandy, 2009). As a consequence, team innovativeness might be more effectively promoted by leaders in profit organizations, consequently yielding more team innovativeness.

## 3.3. Team performance, TMM-TM, and team learning activities

### 3.3.1. The relations between distinct team learning activities and TMM-TM

It has been drawn out that TMM is built through team learning activities (see 2.3.1.). Therefore, team learning activities and TMM should be positively related. However, to date it remains unclear whether this relation holds for the kind of TMM focused in this thesis, namely TMM about the vocational competencies of team members (TMM-TM) (see 2.4., Research Question 3).

First of all the question arises, which kind of team learning activities may be relevant for the team to build up TMM-TM. The investigation of this question is partly informed by the literature on TMS. Elaborating on the mechanisms how a TMS is built, theory on TMS emergence has to explain how shared team-level knowledge about team member competencies occurs. Various authors highlight the importance of team learning in form of communicative interaction processes within the team for the development of TMM-TM in the context of TMS (e.g. Austin, 2003; Jehn & Rupert, 2008; Kozlowski & Bell, 2008; Lewis, 2004; Oertel & Antoni, 2015; Zajac, Gregory, Bedwell, Kramer, & Salas, 2014). In particular,

the team learning activity of knowledge sharing may play an important role in this respect. Ellis, Porter, and Wolverton (2008) argue that team members become aware of each other's competencies by giving information to and requesting information from other team members. Likewise, Wilson et al. (2007) argue that the sharing of knowledge goes hand in hand with the creation of shared team-level knowledge about the competencies of team members. Thus, by sharing knowledge and information, team members learn who has which expertise and who is good at what. Accordingly, Yuan, Fulk, Monge, and Contractor (2010) found a positive relation between the amount of knowledge sharing of individual team members and the amount of shared team-level knowledge concerning team members' occupational competencies as held in the teams TMS. TMM-TM about team members' occupational competencies (TMM-OC) may be generated as team members share their occupational expert knowledge with other team members and are thereby recognized by their teammates to possess knowledge and skills with respect to a specific field of expertise.

However, in this thesis, it is proposed that knowledge sharing may not only foster TMM-TM with respect to team members' occupational competencies, but also with respect to social, meta, and personal competencies. Through the social interaction activities involved in knowledge sharing, team members may realize how social competencies are distributed in the team as they recognize, for example, who has the communicative skills to clearly and understandably articulate her or his knowledge and who has the cooperative ability to be willing to share knowledge. As a consequence, knowledge sharing may also support the development of TMM-TM about team members' social competencies (TMM-SC).

TMM-TM about team members' meta competencies (TMM-MC) may be fostered by knowledge sharing as well. Team members may jointly recognize each other's meta competencies through evaluating on the knowledge that is shared by team colleagues. For example, evaluating on the knowledge shared by a specific team colleague, team members may realize whether this person is good at solving problems, has analytical abilities, and/or applies a structured work approach. Hence, assuming that team members evaluate on the knowledge that is shared by team colleagues, knowledge sharing may enhance the emergence of TMM-MC.

Moreover, through knowledge sharing, team members may jointly recognize each other's personal competencies in terms of attitudes and motives in working on the common task. For example, team members who are motivated to achieve good outcomes for the team should also be motivated to share their knowledge in order to improve team performance (Runhaar et al., 2014). Thus, by observing the knowledge sharing behavior of a specific team

colleague, team members may recognize this person's personal competence in terms of her or his motivation to achieve good outcomes. Consequently, knowledge sharing may also enhance common knowledge structures concerning team members' personal competencies (TMM-PC). Overall, knowledge sharing is hypothesized to be positively related to TMM-TM with respect to occupational, social, meta, and personal competencies.

> Hypothesis 18: Knowledge sharing is positively related to team mental models about team members' vocational competencies (TMM-TM) with respect to occupational (TMM-OC), social (TMM-SC), meta (TMM-MC), and personal competencies (TMM-PC).

Team reflection on task related problems (task reflection) may also be relevant for the development of TMM-TM. Austin (2003) suggests that by discussing task related problems team members refine their initial understanding of each other's expertise and arrive at a more detailed, accurate, and commonly shared mental model of how competencies are distributed in the team. Team reflection on task related problems may foster a common shared understanding about the vocational competencies of team members as it gives team members the opportunity to explore each other's strengths and weaknesses in dealing with the task (Zajac et al., 2014; Oertel & Antoni, 2015). For example, in the task reflection process of an engineering team, a team member may come up with good ideas to solve technical problems concerning a certain kind of machine the team is operating with. Given that these ideas are heard and understood, other team members (who are also present in the social interaction of team reflection) will recognize that this team member has task relevant expert knowledge (occupational competence) with respect to that machine. Consequently, TMM-OC may be fostered by task reflection. Accordingly, Oertel and Antoni (2015) as well as Dayan and Basarir (2010) found a positive relation between task-related team reflection and the team's TMS, which encompasses shared knowledge about occupational competencies.

However, TMM-TM about team members' social, meta, and personal competencies might benefit from task reflection as well. Task reflection may trigger team members to jointly recognize each other's social competencies. For example, by reflecting on task issues team members may jointly recognize who has the competence to eloquently express her or himself while stating arguments on the issue under discussion, or who has the competence to solve problems in cooperation. Thus, task reflection may foster the emergence of TMM-SC.

Furthermore, task reflection may also prompt team members to jointly learn about each other's meta competencies and, hence, foster TMM-MC. For example, the abilities to

solve problems, to be factual, or to apply analytical thinking, which are all meta competencies, are predestinated to be applied during task reflection and, hence, should also be recognized by team colleagues during the interaction processes of task reflection. Therefore, task reflection should foster the emergence of TMM-MC.

In addition, task reflection may also support the emergence of TMM-PC. Reflecting together on task issues, team members may jointly recognize each other's personal competencies in terms of attitudes and motives towards the common task. For example, team members who are highly engaged in and personally identify with the common task may stress their point of view with more passion during task reflection than other team members who are less personally involved. Thus, a team member's personal disposition towards the common task may be recognized by other team members through her or his behavior during task reflection. Consequently, shared knowledge structures about team members' personal competencies might emerge. Overall, it is proposed that shared knowledge structures concerning the distribution of vocational competencies in the team grow stronger as team members are repeatedly working and reflecting together on multiple tasks (Austin, 2003; Oertel & Antoni, 2015). Hence, a positive relation between task reflection and TMM-TM with respect to occupational, social, meta, and personal competencies is hypothesized.

> Hypothesis 19: Task reflection is positively related to team mental models about team members' vocational competencies (TMM-TM) with respect to occupational (TMM-OC), social (TMM-SC), meta (TMM-MC), and personal competencies (TMM-PC).

The role of basic reflection is hardly addressed in the TMS literature. This might be due to two characteristics of that literature. Firstly, the TMS literature mainly refers to shared knowledge about team members' occupational competence (e. g. Austin, 2003; Lewis, 2003; Wegner, 1986), which is to be understood as task-specific knowledge and skills, e. g. the ability to operate a certain kind of machine (see 2.1.2.1). Secondly, occupational competence is envisioned as a belonging of individuals in accordance with Sfard's (1998) "acquisition metaphor" (e.g. Austin, 2003; Ellis et al., 2008: Wegner, 1986). In contrast, basic reflection does not focus on certain details of a specific task and the associated occupational competencies of the persons dealing with that task, but rather on comprehensive issues that relate to the team as a whole (e.g. team goals, work methods of the team). As these issues are not exclusively connected to the occupational competencies of individual experts, basic reflection may lie beyond the scope of the literature on TMS development. Indeed, through reflecting on basic assumptions, team members might not learn much about the occupational

competencies individually held by their teammates. If, for example, team goals are questioned, it is unlikely that occupational competencies of individual team members, like individual expert knowledge in operating a certain machine, are focused in this discussion.

Nevertheless, it is proposed that team members may jointly learn something about each other's social, meta, and personal competencies through basic reflection, yielding TMM-TM with respect to these competencies. Concerning TMM-SC, team members might develop shared knowledge about their team colleagues communicative and cooperative abilities as these become apparent in the process of arguing and compromising during the discussion of basic assumptions. Team members' meta competencies might become apparent through basic reflection as well. For example, it is plausible that in the discussion of basic assumptions team members apply their analytical abilities or the ability to be factual. These meta competencies may then easily be recognized by other team members and, as a consequence, TMM-MC might emerge from basic reflection. Furthermore, TMM-PC may also profit from basic reflection. Personal competencies, in terms of individuals' attitudes and emotional involvement concerning the team's basic assumptions, may become apparent through team members' engagement in basic reflection. For example, if a team member is particularly committed to a certain goal of the team, she or he will presumably be strongly engaged in the discussion of that goal and, hence, her or his commitment will be recognized by other team members. Thus, team members may jointly learn something about each other's personal competencies through the discussion of basic assumptions. Hence, basic reflection should foster the emergence of TMM-PC. Overall, it is assumed that basic reflection may yield shared knowledge structures about team members' social, meta, and personal competencies. Therefore, a positive relation between basic reflection and TMM-TM with respect to social, meta, and personal competencies is hypothesized.

> Hypothesis 20: Basic reflection is positively related to team mental models about team members' vocational competencies (TMM-TM) with respect to social (TMM-SC), meta (TMM-MC), and personal competencies (TMM-PC).

The theoretical model of team learning processes and transactive memory proposed by Oertel and Antoni (2015) suggests that team process reflection is also relevant for the development of TMM-TM. Building on the model of TMS development by Lewis, Lange, and Gillis (2005), they propose that reflection on team interaction processes "sharpen[s] the knowledge of ´who knows what`" (p. 731). After the team has been working together for a while, the questioning of team interaction processes is utilized to optimize teamwork (Gersick, 1988;

Oertel & Antoni, 2015; Sessa & London, 2008b). The refinement of TMM-TM is a part of this optimization process. By reflecting team interaction processes, e.g. the effectiveness and efficiency of communication or how decisions are made in the team, team members think about their roles in the team and the roles of their teammates as well as the competencies associated with these roles. This reflection process might create a stronger and more accurate common picture of how competencies are distributed in the team. For example, team members may apply team process reflection to achieve more effective and efficient communication in the team. Thereby, team members may seek to optimize the flow of information by reflecting and refining their picture of team members' roles with respect to the occupational competencies they hold, leading to an improved collective awareness of who has which occupational competencies (TMM-OC). As a result of this reflection process, team members may forward specific information directly to the person in the team who has the necessary occupational competence to deal with and make use of the information.

Moreover, TMM-SC might also benefit from team process reflection. As in case of task reflection and basic reflection, team members might jointly learn about their team colleagues' communicative and cooperative abilities through team process reflection, as these abilities are likely to become visible during the activities of arguing and reflecting in the context of team reflection. In addition, team members' cooperative abilities may be directly focused in team process reflection as these are highly relevant for team interaction processes (Heyse & Erpenbeck, 2007), and, therefore, likely to be addressed in the discussion of these processes. For example, if the effectiveness and efficiency of communication in the team is discussed, team members' communicative and cooperative skills will presumably be addressed. The resulting collective attention on team members' social competencies may support the emergence of TMM-SC.

Furthermore, team process reflection may also foster TMM-MC. As in case of task reflection and basic reflection, the process of discussing relevant issues together, which is also substantial for team process reflection, may cause team members to jointly realize whether individual teammates possess the meta competencies of analytical and systematic thinking and the ability to stay factual during discussions. In addition, discussing their roles and associated competencies in the course of team process reflection, team members may directly address each others' meta competencies. Thereby they may realize, for example, who is good at problem-solving, managing processes, or acquiring new knowledge. Consequently, TMM-MC might emerge from team process reflection.

TMM-PC may be fostered by team process reflection as well. When discussing whether the team is effectively working together, which is a crucial part of team process reflection, team members may realize each other's personal competencies in terms of attitudes and motives towards the common task. For example, team members that are highly motivated to achieve good teamwork-outcomes may take up a more critical position towards the effectiveness of team interaction than team members that are less motivated. Hence, team members' personal competencies may become visible through their behavior during the activities of arguing and reflecting in the context of team process reflection. In addition, team members' attitudes and motives towards the common task should also become apparent if their roles in the team are discussed in the course of team process reflection. For example, the engagement and motivation of a certain team member might become clear to other team members as the discussion of her or his role in the team highlights this team member's significance within the context of group interaction. As a consequence, team process reflection may support the development of shared knowledge structures with respect to TMM-PC. Hence, a positive relation between team process reflection and TMM-TM with respect to occupational, social, meta, and personal competencies is expected.

> Hypothesis 21: Team process reflection is positively related to team mental models about team members' vocational competencies (TMM-TM) with respect to occupational (TMM-OC), social (TMM-SC), meta (TMM-MC), and personal competencies (TMM-PC).

Storage and retrieval by use of material repositories is not expected to affect TMM-TM. Studies on the relation between team interaction processes and TMS suggest that face-to-face interaction is crucial for TMM-TM to emerge (Hollingshead, 1998; Lewis, 2004). For example, Lewis (2004) found that non face-to-face communication via e-mail and telephone had no effect on TMS emergence. She concludes that the information richness of face-to-face communication in terms of conveying verbal and nonverbal information is important for shared knowledge about team member competencies to emerge. Storage and retrieval by use of material repositories is not primarily performed in face-to-face interaction, but rather through interaction with artifacts, e.g. team documents or computer databases. Therefore, no relation between storage and retrieval and TMM-TM is expected.

### 3.3.2. The relations between TMM-TM and team performance

As has been drawn out, theoretical considerations as well as sound empirical evidence suggest that TMM is positively related to team performance (see 2.3.1.). However, to date it has not been investigated whether this positive relation is also given with respect to the kind of TMM focused in this thesis, namely TMM-TM about team members' occupational, social, meta, and personal competencies (see 2.4., Research Question 4). Thus, the relation between TMM-TM and team performance has to be elaborated.

Different authors have pointed out that team members need to generate shared knowledge structures concerning each other's competencies to maximize team performance (Cannon-Bowers & Salas, 2001; Collins, Brown, & Newman, 1989; Santos et al., 2015; Wenger, 2000).

> This type of shared knowledge should benefit task performance by helping team members to compensate for one another, predict each other's action, provide information before being asked and allocate resources according to member expertise. That is, as team members become more familiar with one another, they can adjust their own behavior in accordance with what they expect from teammates. (Cannon-Bowers & Salas, 2001, p. 197)

Cannon-Bowers and Salas (2001) compare the improved performance abilities of a team due to a strong TMM-TM with the "blind" or "no-look" pass in basketball, where the player is able to blindly predict where his/her teammates stand and what these are capable of doing. Thus, it is due to improved processes of implicit team coordination that TMM-TM unfolds its benefits for team performance (DeChurch & Mesmer-Magnus, 2010; Mathieu et al., 2000; Mohammed et al., 2010, see 2.3.1.). Improving implicit team coordination, TMM-TM is useful for team performance across a variety of tasks and situations (Cannon-Bowers & Salas, 2001). Furthermore, applying a similar argumentation as advocated in the TMM-literature, the theoretical literature on the effects of TMS suggests that shared knowledge about team members' occupational competencies positively affects team coordination and performance (e.g. Chatterjee, 2016; Ellis et al., 2008; Moreland, 1999).

Some tentative empirical evidence for a positive relation between TMM-TM and team performance comes from studies demonstrating a positive link between TMM regarding team interaction, which is also expected to unfold its benefits for team performance through improving implicit coordination, and team performance (e.g. Ellis, 2006; Gurtner et al., 2007; Mathieu et al., 2000; Rentsch & Klimoski, 2001). In addition, studies demonstrating a positive relation between TMS and team performance are speaking in favor of a positive link

between TMM-OC and team performance (e. g. DeChurch & Mesmer-Magnus, 2010; Huang, Liu, & Zhong, 2013; Kozlowski & Ilgen, 2006; Oertel & Antoni, 2015). However, the relations between TMM-TM with respect to occupational, social, meta, and personal competence and team performance with respect to effectiveness, efficiency, and innovativeness (see 2.1.2.2.) have not been tested yet directly in an empirical study. Thus, it remains an open question what common knowledge (regarding which particular team member competencies) needs to be held in the TMM-TM to foster team performance (see 2.4.).

TMM-OC might foster team effectiveness as it enables team members to capitalize on each other's occupational competencies. Having a shared awareness of who has which specialized occupational knowledge and skills, the team may effectively use the occupational competencies distributed among team members during task execution and, consequently, team effectiveness may be enhanced (Austin, 2003; Ellis et al., 2008; Moreland, 1999). Furthermore, TMM-OC may foster team efficiency and effectiveness through supporting fluent coordination among team members (DeChurch & Mesmer-Magnus, 2010; Moreland, 1999). For example, if team members share TMM knowledge about who has which occupational competencies, they know which team member holds specific expert knowledge and for whom specific information is relevant. Thus, team members may more fluently forward information to and obtain information from the relevant persons in the team (Chatterjee, 2016). With respect to team innovativeness, Farr, Sin, and Tesluk (2003) argue that team members need to have shared knowledge about each other's expert knowledge in order to capitalize on that knowledge for developing innovative solutions. The argument is supported by study results from Stasser et al. (1995). Conducting an experimental study, they found that members of groups holding shared knowledge about each other's expertise are more likely to bring their individual expert knowledge to the task-related discussion, whereas groups that lack this shared knowledge are more likely to discuss information that is already known to all group members. Since it is necessary for team innovativeness that team members capitalize on diverse perspectives and expert knowledge (West, 2002), team innovativeness might be supported by TMM-OC as it may encourage team members to contribute their individual expert knowledge and, thereby, enrich the task-related discussion. Furthermore, fostering fluent coordination among team members, TMM-OC might support team innovativeness by enabling a smooth work-flow that fosters the application of creative ideas. Overall, TMM-OC is hypothesized to be positively related to team performance with respect to team effectiveness, team efficiency, and team innovativeness.

Hypothesis 22: Team mental model about team members' occupational competencies (TMM-OC) is positively related to team performance (effectiveness, efficiency, innovativeness).

Team performance with respect to team effectiveness and efficiency may also be enhanced by TMM-SC. Communication should function more fluently if team members have a shared awareness about the distribution of social competencies in the team. For example, if a team member needs to resolve a problem which already has been solved by other team members and she or he needs to decide which team colleague to ask for advice, TMM-SC may help the team member to identify those colleagues who have the social competencies to communicate information in an understandable and helpful fashion, as well as to help team colleagues by sharing their knowledge. Consequently, the flow of information in the team might be enhanced by TMM-SC, leading to improved team effectiveness and efficiency (Chatterjee, 2016). In contrast, team innovativeness is not supposed to be enhanced by TMM-SC. Knowing who has which social competence may not be sufficient to foster the process of creating and applying innovative ideas. However, TMM-SC may be somewhat supportive for the process of idea generation. For example, if team members know which persons have the communicative skills to stimulate the discussion of ideas, they may turn to these persons to moderate idea generation. Nevertheless, TMM-SC is presumably not crucial for the process of idea application. The application of ideas requires the team to engage in a learning process and to take the risk of failure (Bowers & Khorakian, 2014; West & Sacramento, 2006). Shared knowledge about team members' social competencies, e.g. their communicative and cooperative skills, might not support idea application as it may neither foster the team's engagement in a learning process nor may it empower the team to take the risk of failure. Hence, TMM-SC is hypothesized to be positively related to team performance with respect to team effectiveness and team efficiency, but not with respect to team innovativeness.

Hypothesis 23: Team mental model about team members' social competencies (TMM-SC) is positively related to team performance (effectiveness, efficiency)

TMM-MC might foster team performance as well. Knowing which team members possess the meta competencies of, for example, problem solving, creativity, or analytical thinking may help team members to identify persons in the team who have the ability to successfully deal with problems that arise during the execution of complex, unstructured, and non-routine tasks. Consequently, such demanding tasks may be taken over by team members possessing these meta competencies or these team members may be consulted by team colleagues that are

confronted with complex problems. Hence, TMM-MC may enable the team to execute complex, unstructured, and non-routine tasks better, faster, and more easily improving team effectiveness and efficiency. Team innovativeness might benefit from TMM-MC as well. The creative human resources of team members are better accessible to the team in case of shared knowledge about team members' meta competencies, since commonly held information about team members' creativity and about their abilities regarding innovative/unconventional thinking are stored in the TMM-MC. Capitalizing on that shared knowledge, the generation of creative ideas for team innovativeness might be conducted by team members possessing creative abilities. Moreover, TMM-MC may also support the process of idea application. Shared knowledge structures concerning the meta competencies of, for example, problem solving, applying a systematic work approach, or being willing and able to learn, may support the identification of team members who have the necessary competence to engage and succeed in the learning processes associated with idea application. Consequently, these team members may be consulted when it comes to idea application during the process of team innovativeness. Overall, TMM-MC is hypothesized to be positively related to team performance with respect to team effectiveness, team efficiency, and team innovativeness.

> Hypothesis 24: Team mental model about team members' meta competencies (TMM-MC) is positively related to team performance (effectiveness, efficiency, innovativeness).

Furthermore, team performance might also be fostered by TMM-PC. Holding shared knowledge about team members' personal competencies of, for example, being motivated and determined to productively apply the own workforce in service of the common task, to take over responsibility, and to stay calm in stressful situations, may help the team to realistically estimate the achievement potential of its individual members. Consequently, tasks and roles in the team may be assigned to team members in accordance with their achievement potential. This should lead to improved team performance with respect to effectiveness and efficiency. Furthermore, TMM-PC may also improve team innovativeness. It is proposed that TMM-PC might be supportive with respect to team innovativeness as it indicates whether team members are committed to the process of realizing innovative ideas. Sharing distinct TMM-PC knowledge about team members' positive motivational and emotional involvement with the team's vocational task, the readiness to take and overcome risks and strains associated with the realization process of team innovativeness may be enhanced, since team members are recognized by their team colleagues as possessing the motivational and emotional capabilities necessary for the application of innovative ideas. Hence, the application of innovative ideas

and, consequently, team innovativeness may be enhanced by TMM-PC. Overall, TMM-PC is hypothesized to be positively related to team performance with respect to team effectiveness, team efficiency, and team innovativeness.

Hypothesis 25: Team mental model about team members' personal competencies (TMM-PC) is positively related to team performance (effectiveness, efficiency, innovativeness).

The developed hypotheses concerning relations between team learning activities, TMM-TM, and team performance are summed up in Research Model 5 (Figure 5).

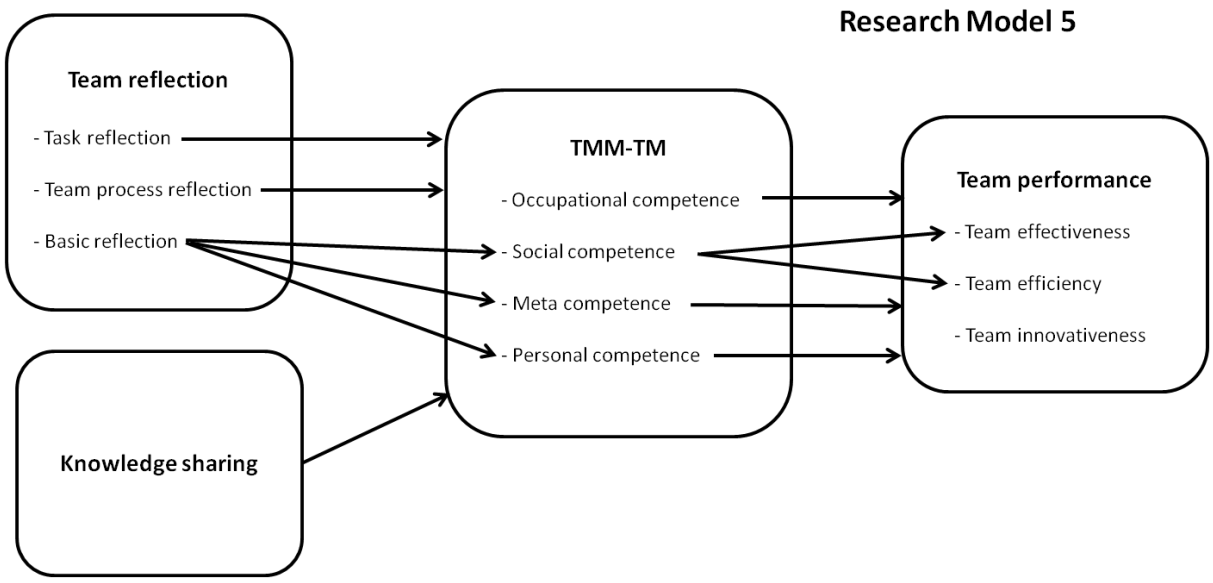


*Figure 5.* Research Model 5: Hypothesized relations between team learning activities, TMM-TM, and team performance. Positive relations are hypothesized. Arrows ending at the frame of a box indicate that a relation is hypothesized with respect to all constructs inside the box.

### 3.3.3. Control variables

Apart from the investigated team learning activities, the emergence of TMM-TM is probably also influenced by other variables. Two variables that are potentially important in this respect are investigated as control variables: (1) Team size and (2) teamwork time.

(1) Team size is included as a control variable because Rentsch and Klimoski (2001) found a negative relation between team size and TMM about teamwork. They argue that in larger teams team members have fewer opportunities to interact with everybody in the team

and, therefore, less common knowledge about the team is developed. Thus, team size might also negatively affect TMM-TM with respect to team members' occupational, social, meta and personal competencies.

The amount of time individuals spend working together as a team has been identified as a critical determinant of building team-related TMMs (Mohammed et al., 2010; Levesque et al., 2001; Rico et al., 2008). "Extensive social relationships, socialization processes, mutual learning, and repeated practice operate to increase the convergence and accuracy of team members' mental models over time (e.g., Langan-Fox, Anglim, & Wilson, 2004; Levesque, Wilson, & Wholey, 2001; Mathieu et al., 2000; Rentsch & Woehr, 2004)" (Rico et al., 2008, p. 171). Empirical studies indicate that the time of working together as a team is positively correlated with the strength of team-related TMMs (e.g. Liang, Moreland, & Argote, 1995; Moreland, 1999; Smith-Jentsch, Campbell, Milanovich, & Reynolds, 2001). However, given that organizational work teams are acting in a dynamic environment (Sessa & London, 2008b), team membership as well as teamwork tasks may probably change over time (Kozlowski & Bell, 2008). As a consequence, changes concerning the team and its environment need to be constantly mirrored by the shared knowledge structures of the team. For example, if a team member is replaced by a new team member, the shared knowledge about the replaced colleague loses its relevance and new shared knowledge about the new colleague has to be acquired. Hence, TMM-TM depends on the current collaborative situation (Rico et al., 2008). Therefore, shared knowledge with respect to TMM-TM is not expected to necessarily increase as a function of overall team existence duration, since membership changes may render this knowledge partly obsolete, but rather as a function of the amount of time the team is currently working together on the teamwork task. The time of currently working together on the teamwork task is measured by the control variable of (2) teamwork time, indicating the average amount of weekly time (in hours) team members currently spend working together on the common task. Teamwork time might positively affect TMM-TM with respect to occupational, social, meta and personal competencies.

# 4. The empirical study

## 4.1. Sample and design

Teams included in the sample had to fulfill two criteria. Firstly, teams had to be organizational work teams according to the definition of Jehn and Rupert (2008). This implies that teams (a) had to consist of at least two members, (b) had to recognize themselves and had to be recognized by others as a group, (c) had to share responsibility for a specific team product or

service, and (d) had to operate within an organization. Secondly, in order to ensure that team learning was relevant for the investigated teams, teams had to be complex decision-making teams (see 1.). Hence, the teams' work tasks had to be (a) complex – meaning that various task components are combined and integrated by team members, (b) unstructured – meaning that the task allows for multiple courses of action, goals and possible solutions, and (c) non-routine – meaning that substantial elements of the task or the work environment may change daily in hardly predictable ways (cf. West, 1996). In advance of the data collection, one experienced team member, mostly the team leader, was appointed as contact person within each team. The contact person was asked to give a description of the team and the team's task. These descriptions were evaluated with respect to the indicated criteria. Teams not meeting the criteria were excluded from participation.

A cross-sectional survey study was carried out. Team members filled in a questionnaire. Team performance was measured with an additional questionnaire that was handed out to team supervisors. Applying a third questionnaire, an experienced team member (preferably and mostly the team leader) was asked to indicate the team's work field and the organization's profit orientation. The acquisition of teams as well as the data collection was assisted by students enrolled in a master project course at the University of Regensburg. Teams were questioned at their organizations. For a team to be included in the sample, at least two-thirds of its members had to participate in the study. In sum, $N_1 = 75$ teams coming from 35 different organizations located in southern Germany participated in the study. Teamwork was situated in challenging domains, e.g. training and development, information technology, social work, industrial research and development (see Table 1).

All participating teams were complex decision-making teams whose tasks matched the outlined criteria. Tasks were, for example, in the domain of social work and psychological counseling, to organize and take care of living groups of disabled people, in the domain of vocational training and development, to plan and conduct on-the-job training for employees, in the domain of administration and project management, to organize and manage organizational development, in the domain of industrial research and development, to develop new technical systems for the automobile sector, in the domain of information technology, to develop applications for android mobile phones, in the domain of human resource management, to develop concepts for organizational human resource development, and in the domain of academic research, to conceive and conduct an academic research project.

Table 1

*Domains of Teams Included in the Full Sample ($N_1$ = 75 Teams)*

| Work field | Number of teams |
|---|---|
| Social work, psychological counseling | 18 |
| Administration, project management | 11 |
| Training and development, adult education | 10 |
| Industrial research and development | 9 |
| Building, constructing, engineering | 7 |
| Information technology | 6 |
| Human resource management | 4 |
| Academic research | 4 |
| Media design, communications design | 3 |
| Healthcare | 2 |
| Marketing | 1 |

Communicating with the respective contact person of each team, it was straightened out in advance of the data collection whether study questions were passable for the team and the organization. This step was necessary as not all participating teams were willing and able to raise the necessary time and readiness to answer all questions. Critical questions in this respect were (1) questions concerning leadership, which were seen critical due to their relatedness to one specific person in the team, (2) questions concerning the measurement of TMM-TM, which were seen critical because they were very time-consuming, and (3) questions concerning team performance that had to be answered by the team's supervisor, which were critical due to the availability of the supervisor. Therefore, considering their time resources and readiness to fill in study questions, teams were provided with four different options of participation: (1) Participation in the complete study with all questions; (2) participation without answering questions concerning leadership; (3) participation without answering questions concerning TMM-TM; (4) participation without answering questions concerning leadership and TMM-TM. Options 2-4 were only communicated to the contact person if she or he excluded option 1. The additional questionnaire measuring team performance was administered if the respective supervisor of a team was available and willing to answer the questions. Team supervisor ratings could be collected for 63 teams.

Due to the four different options of participation and the availability of team supervisors, the available data base is varying with respect to the four Research Questions. For the investigation of Research Question 1 (What beliefs about the team's interpersonal context are related to which team learning activity?), the full sample of all participating teams was available since the variables of transformational leadership and TMM-TM, for which the corresponding questions optionally could be omitted (options 2-4), and the performance appraisal of the team's supervisor are not relevant with respect to this research question. The data base for the investigation of Research Question 1 consists of $n_1$ = 359 members of $N_1$ = 75 teams. 38 teams were coming from profit organizations, 37 teams from non-profit organizations. The 75 teams overall consisted of 413 team members, thus, 86.92% of all team members participated in the study. Average team size was 5.63 (*SD* = 2.50, min = 2, max = 14). Respondents average age was 35.23 years (*SD* = 10.42, min = 20, max = 63), 56.8% were female, and 62.4% were holding an academic degree.

With respect to Research Question 2 (What is the mediating role of team reflection in the relation between transformational leadership and team innovativeness?), the available data base consisted of those teams that either chose option 1 (full participation) or 3 (omit questions concerning TMM-TM). The resulting sample consisted of $N_2$ = 37 teams coming from 17 different organizations. 18 teams were coming from profit organizations, 19 teams from non-profit organizations. Team supervisor ratings of team performance were available for all 37 teams. The 37 teams overall consisted of 223 team members, from which $n_2$ = 184 participated in the study (82.51%). Average team size was 6.02 (*SD* = 2.25, min = 3, max = 11). Respondents average age was 37.59 years (*SD* = 10.96, min = 20, max = 63), 63.6% were female, and 56.83% were holding an academic degree. Table 2 shows the distribution of teams included in the investigation of Research Question 2 with respect to the domains they were working in.

Table 2

*Domains of Teams Included in the Investigation of Research Question 2 ($N_2$ = 37 Teams)*

| Work field | Number of teams |
|---|---|
| Social work, psychological counseling | 15 |
| Administration, project management | 6 |
| Training and development, adult education | 4 |
| Information technology | 4 |
| Industrial research and development | 3 |
| Human resource management | 2 |
| Media design, communications design | 2 |
| Healthcare | 1 |

With respect to the investigation of Research Questions 3 (How are team learning activities related to TMM-TM?) and 4 (How is TMM-TM related to team performance?), teams were available that either chose option 1 (full participation) or 2 (omit questions concerning leadership). The resulting sample consisted of $N_3$ = 63 teams from 33 different organizations. 28 teams were from profit organizations, 35 teams from non-profit organizations. Team supervisor ratings of team performance were available for $N_4$ = 54 of these teams. The 63 teams overall consisted of 357 members, from which $n_3$ = 304 participated in the study (85.15%). Average team size was 5.67 (*SD* = 2.29, min = 3, max = 12). The average age of respondents was 35 years (*SD* = 10.41, min = 20, max = 63), 61.8% were female, and 62.83% were holding an academic degree. Table 3 shows the distribution of teams included in the investigation of Research Questions 3 and 4 with respect to work domains.

Table 3

*Domains of Teams Included in the Investigation of Research Questions 3 and 4 ($N_3$ = 63 Teams)*

| Work field | Number of teams |
|---|---|
| Social work, psychological counseling | 17 |
| Administration, project management | 10 |
| Training and development, adult education | 9 |
| Information technology | 6 |
| Industrial research and development | 5 |
| Human resource management | 4 |
| Building, constructing, engineering | 3 |
| Academic research | 3 |
| Media design, communications design | 3 |
| Healthcare | 2 |
| Marketing | 1 |

## 4.2. Instruments

Due to the four different options of participation**,** the available data base for testing the study instruments with respect to reliability and validity is differing for some of the applied instruments. In the following paragraphs, it is indicated which data base was available for testing the respective instrument. Unless indicated otherwise, statistical analyses were carried out with the software *IBM SPSS Statistics 23*.

### 4.2.1. Team learning activities

Team learning activities were rated by team members using Likert-type scales ranging from 1 (*never)* to 5 (*very often*). Scales and items that were originally published in English were translated from English to German and, in order to ensure accurate translation, back from German to English. If necessary, formulations were corrected to preserve the original meaning of items. The full sample of $n_1$=359 members of $N_1$=75 teams was available for testing the scales measuring team learning activities with respect to reliability and validity.

Knowledge sharing was measured with the knowledge sharing scale by Connelly & Kelloway (2003), consisting of five items as published by Staples & Webster (2008), complemented by three self developed items. Example items are “People in this team share

their ideas openly" and "In the team we exchange about our practical experiences regarding the common task" (see Appendix A.1. for full scales). Cronbach's alpha for the scale was satisfactory ($\alpha = .86$).

For the measurement of team reflection with respect to the dimensions of task reflection, basic reflection, and team process reflection, three new scales were developed based on items from the team reflexivity scales by Schippers et al. (2007). Items of the team reflexivity scales were screened and subsequently allocated to one of the three dimensions of team reflection. If no distinct allocation was possible, items were discarded. This procedure yielded five items for task reflection, seven items for basic reflection, and four items for team process reflection. To test this allocation with respect to construct validity, an exploratory factor analysis (EFA) using oblique factor solution (promax) was conducted. EFA was chosen because the distinction of three different dimensions of team reflection is newly introduced and the factor structure of the corresponding set of items has not been analyzed before (cf. Matsunaga, 2010). Oblique factor solution was chosen because different dimensions of team reflection were expected to be correlated. The Kaiser-Meyer-Olkin coefficient of $KMO = .92$ indicated that that the set of items was suited very well for conducting the EFA (Bühner, 2011). Three factors with an Eigenvalue above 1 explaining 57 per cent of the total variance were found in the analysis. Five criteria were applied to assess construct validity and internal consistency of the created scales. (1) Main factor loadings of items allocated to the same construct had to be on the same factor, (2) main factor loadings had to be $\lambda > .40$, (3) the difference between an items' main factor loading and cross-loadings had to be $\lambda > .20$, (4) cross-loadings had to be $\lambda < .30$ and (5) Cronbach's $\alpha$ of each resulting scale had to be $\alpha > .70$. One item allocated to task reflection and three items allocated to basic reflection were discarded for not meeting the set out criteria. Afterwards, each team reflection scale consisted of four items. Main factor loadings ranged from .44 to .75 for task reflection, from .52 to .84 for basic reflection, and from .59 to .75 for team process reflection. Example items for task reflection are "If things don't work out as planned, we consider what we can do about it" and "If a team member discovers a problem, he or she will talk about it with other team members". Example items for basic reflection are "We question our objectives" and "If conditions change, we review our work methods". Example items for team process reflection are "We discuss whether the team is working effectively" and "We reflect on the way how we make decisions". Cronbach's alpha values of the scales were satisfactory (task reflection, $\alpha = .76$; basic reflection, $\alpha = .79$; team process reflection, $\alpha = .79$). The results of the EFA are displayed in Table 4.

Table 4

*Loadings of Team Reflection Items[1] on the Factors Task Reflection (TR), Basic Reflection (BR), and Team Process Reflection (TPR)*

| Items | Task Reflection | Basic Reflection | Team Process Reflection |
|---|---|---|---|
| 1. Discuss different ways of reaching objectives (TR) | **.54** | .01 | .15 |
| 2. Talk about problems with other team members (TR) | **.75** | -.19 | -.01 |
| 3. Evaluate things that don't work out as planned (TR) | **.71** | .14 | -.17 |
| 4. Consider problems from different points of view (TR) | **.44** | .13 | .21 |
| 5. *Find possible cause of problems (TR)* | .40 | .21 | .16 |
| 6. Review objectives of the team (BR) | -.02 | **.84** | -.06 |
| 7. Review work methods as a result of changes (BR) | .26 | **.56** | -.16 |
| 8. Question objectives (BR) | -.15 | **.85** | .02 |
| 9. Work out what can be learned from past experiences (BR) | .19 | **.52** | -.10 |
| 10. *Analyse success (BR)* | -.17 | .53 | .36 |
| 11. *Evaluate objectives in case of changing circumstances (BR)* | .34 | .24 | .21 |
| 12. *Discuss methods used to get the job done (BR)* | .28 | .25 | .18 |
| 13. Discuss if the team is working effectively (TPR) | .12 | -.08 | **.69** |
| 14. Discuss communication of information (TPR) | .06 | -.21 | **.75** |
| 15. Reflect on way of decision making (TPR) | -.14 | .11 | **.75** |
| 16. Reflect on way of communication (TPR) | .00 | .12 | **.59** |

*Note.* $N$ = 338, listwise deletion. PAF with promax rotation. Explained variance (cumulative): 57%. Main factor loadings of items fulfilling the indicated criteria are in bold print.

[1] Short versions of items are given. Items printed in italics were discarded. The allocation of items to constructs is indicated in brackets.

In addition to this multidimensional measure, a unidimensional measure of team reflection was created. The unidimensional measure was applied in the investigation of Research Question 2, since the development of hypotheses regarding different dimensions of team reflection was not reasonable for this research question (see 3.2.1., 3.2.2.). The assumption of a unidimensional structure of the team reflection scales as an alternative to the proposed multidimensional structure was supported by Velicer's minimum average partial (MAP) test (see O'Connor, 2000), which yielded one factor to be extracted. Therefore, a second factor analysis was conducted with the 16 items measuring team reflection, whereas one factor was set to be extracted. The one-factor solution explained 41 per cent of the total variance. To warrant construct validity of the created scale, factor loadings were evaluated. Items with a

factor loading of $\lambda \geq .6$ were included in the scale (Matsunaga, 2010). Four items were discarded for not meeting this criterion. The final scale consisted of three task reflection items, six basic reflection items, and three team process reflection items. Cronbach's alpha confirmed the internal consistency of the scale ($\alpha = .89$). The results of the one-factor solution are displayed in Table 5.

Table 5

*Unidimensional Factor Loadings of Team Reflection Items*[1]

| Items | Factor loading |
|---|---|
| 1. Discuss different ways of reaching objectives (TR) | **.60** |
| 2. *Talk about problems with other team member (TR)* | .45 |
| 3. *Evaluate things that don't work out as planned (TR)* | .58 |
| 4. Consider problems from different points of view (TR) | **.68** |
| 5. Find possible cause of problems (TR) | **.67** |
| 6. Review objectives of the team (BR) | **.68** |
| 7. Review work methods as a result of changes (BR) | **.60** |
| 8. Question objectives (BR) | **.64** |
| 9. *Work out what can be learned from past experiences (BR)* | .54 |
| 10. Analyse success (BR) | **.63** |
| 11. Evaluate objectives in case of changing circumstances (BR) | **.69** |
| 12. Discuss methods used to get the job done (BR) | **.62** |
| 13. Discuss if the team is working effectively (TPR) | **.60** |
| 14. *Discuss communication of information (TPR)* | .48 |
| 15. Reflect on way of decision making (TPR) | **.60** |
| 16. Reflect on way of communication (TPR) | **.61** |

*Note.* $N = 338$, listwise deletion. PAF with one factor set to be extracted. Explained variance: 41%. Factor loadings of items fulfilling the indicated criterion are in bold print.

[1] Short versions of items are given. Items printed in italics were discarded.

Storage and retrieval was measured with a five item scale consisting of three items adapted from Van Offenbeek (2001) and two self developed items. Analysis of internal consistency yielded that one item ("We are creating minutes from team meetings") had to be excluded from further analysis. With respect to the four remaining items, Cronbach's alpha was

satisfactory (α = .71). Example items are “We are storing our knowledge in a common archive” and “We are using team documents which are created by the team for the team”.

To validate the proposed operationalization of team learning activities as a multidimensional construct consisting of the five different dimensions of knowledge sharing, task reflection, basic reflection, team process reflection, and storage and retrieval, it is necessary to assess whether this structure of five dimensions fits the data (see e.g. Savelsbergh et al., 2009; Schippers et al., 2008). For this purpose, a confirmatory factor analysis (CFA) was carried out using the software package *Mplus 6*. CFA was conducted with individual level data since the different dimensions of team learning activities are perceived by individuals and, thus, should be mirrored by the answers of individual participants. As suggested by Brown (2006), three different kinds of model fit indices were considered.

(1) Absolute fit indices evaluate the reasonability of the hypothesis that the specified model is capable of exactly reproducing the population covariance matrix (Brown, 2006; Raykov & Marcoulides, 2006). A very commonly used index for absolute fit is the chi-square index. However, chi-square is rarely used solely as index of model fit as it has been criticized for different reasons, like its dependence on sample size and the stringent hypothesis assumed in the chi-square test that the model implied covariance matrix equals the estimated population covariance matrix (Brown, 2006). An alternative absolute fit index is the standardized root mean square residual (SRMR). The SRMR indicates the average discrepancy between the correlations observed in the input matrix and the correlations predicted by the model (Brown, 2006). Thus, smaller SRMR values indicate better model fit. According to Hu & Bentler (1999), a SRMR of .08 and lower indicates acceptable model fit.

(2) Indices incorporating parsimony correction consider the number of freely estimated parameters in a model (Brown, 2006). A widely used index from this category is the root mean square error approximation (RMSEA). The RMSEA assesses the extent to which a model fits the population reasonably well (Brown, 2006). Thus, the conventional null hypothesis that a proposed model perfectly fits the population covariance is relaxed (Raykov & Marcoulides, 2006). Hu & Bentler (1999) suggest that RMSEA values of .06 and lower indicate acceptable model fit.

(3) Comparative fit indices evaluate the fit of the specified model in relation to a null model in which covariances among all input indicators are fixed to zero (Brown, 2006). Two comparative fit indices are evaluated: The comparative fit index (CFI) and the Tucker-Lewis index (TLI). Interpreting these indices, values equal or greater than .90 are usually taken as a sign for acceptable model fit (e.g. Byrne, 2012; Van de Schoot, Lugtig & Hox, 2012).

In sum, acceptable model fit was considered to be given if the following standard fit indices met the indicated criteria: *SRMR* ≤ .08, *CFI* ≥ .90, *TLI* ≥ .90, *RMSEA* ≤ .06 (Byrne, 2012; Hu & Bentler, 1999). Two criteria were used for the evaluation of factor loadings. (1) Loadings had to be significant at the $p < .001$ level and (2) had to exceed the threshold of $\lambda > .45$ (Comrey & Lee, 1992). All 24 items from the five team learning scales were included in the model. Corresponding to the five different team learning activities, a five-factor model was estimated. Modeling was conducted using maximum likelihood estimates with robust standard errors (MLR), which are robust with respect to non-normality of the data (Christ & Schlüter, 2012; Muthén & Muthén, 2010). This was necessary since Kolmogorov-Smirnov and Shapiro-Wilk normality tests indicated that normality is not given with respect to the variables in the model. Fit indices ($\chi^2 = 444.22$, $df = 242$, $p < .01$; CFI = 0.92; TLI = 0.91; SRMR = 0.056; RMSEA = 0.048) as well as standardized factor loadings (.50 - .79) were acceptable, supporting the five-factor model. Finally, since previous studies suggested a unidimensional operationalization of team learning activities, the five-factor model was compared to a one-factor model. As the MLR estimator was used, the difference between $\chi^2$-values of the models was corrected applying the procedure developed by Satorra and Bentler (2001), as described by Christ and Schlüter (2012). The one-factor model yielded a poor model fit ($\chi^2 = 1020.11$, $df = 252$, $p < .01$; CFI = 0.71; TLI = 0.68; SRMR = 0.086; RMSEA = 0.092) and chi-square difference testing showed significant improvement in model fit in favor of the five-factor model ($\chi^2_{diff} = 420.37$, $df = 10$, $p < .01$). These results support the distinction of five different team learning activities.

### 4.2.2. Team learning products

#### 4.2.2.1. TMM-TM

TMM-TM was investigated applying a qualitative research approach. Two open questions were posed. Participants were asked to indicate for each individual team colleague, (1) which competencies they think a person has that are relevant for the team's common task, and (2) how the person applies these competencies in the team's common task. Competencies were inquired along with their practical application for two reasons. First, to ensure that the indicated competencies were relevant for the common teamwork task, and second, because competencies necessarily encompass the possession and application of knowledge and skills (Mulder & Gruber, 2011). Data for the measurement of TMM-TM was available from $n_3 = 304$ member of $N_3 = 63$ teams.

TMM-TM was analyzed and quantified by first extracting the individual mental models of participants from the given answers and then filtering the intersection of mental models of individuals within a team (see Carley, 1997). Individual team members' mental models were extracted from the collected qualitative data using content analysis identifying the concepts of vocational competence that respondents attribute to a specific team member. A category system for coding vocational competencies was developed combining deductive and inductive category building (see Appendix A.2.). Four main categories of vocational competence – occupational, social, meta, and personal competence – were deduced from the organizational literature (Mulder & Gruber, 2011; Sonntag & Schaper, 2006). Further, more fine grained categories of concepts assigned to these main categories were induced from the data material. Content analysis of the qualitative data was carried out using the software MAXQDA 10. To assess interrater reliability of the coding procedure, part of the data (eight teams, 41 respondents) was coded independently by two researchers and, subsequently, Cohen's kappa (1968) was calculated. The analysis yielded a coefficient of $\kappa = .92$, strongly supporting interrater reliability. After coding the individual responses, answers given by different participants relating to the same team member were compared and identical codings were counted to capture the TMM-TM. Team members were anonymously identified by use of tokens indicating who is referring to whom. An example TMM-TM of a team in the sample is depicted in Figure 6.

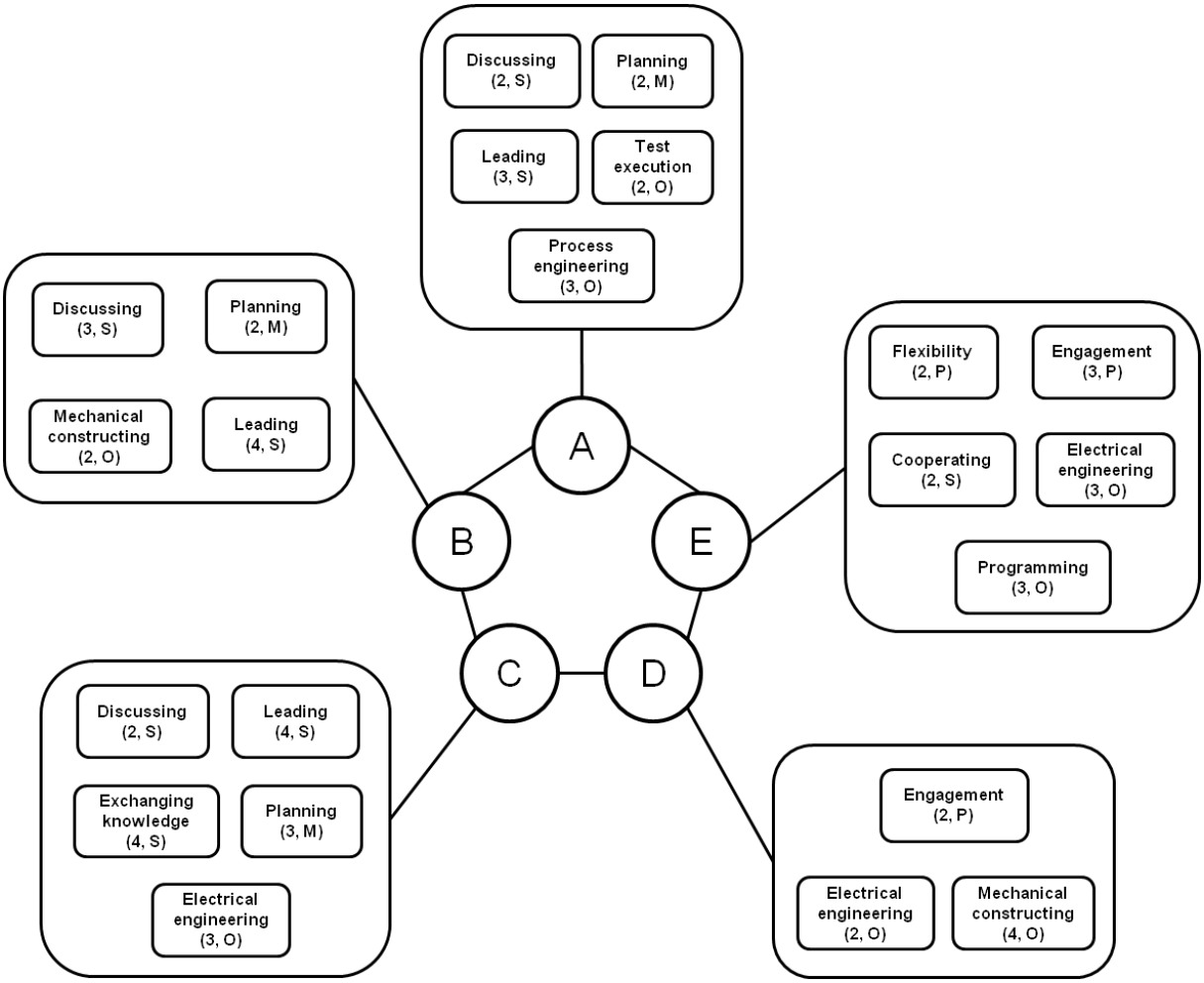


*Figure 6.* Example TMM-TM of a team in the sample. Team members are represented by the letters A-D. Categories with overlapping concepts between team members are given in the boxes connected to the respective team members. The number added in parentheses indicates the number of team members sharing a specific concept with respect to the respective person. The letter indicates the main category the concept was assigned to, whereas O stands for occupational, S for social, M for meta, and P for personal competence.

The measurement of TMM has to comprise team mental model content and structure (Mohammed et al., 2010). With respect to the applied measurement method, TMM content is represented by team members' shared knowledge regarding task-relevant vocational competencies in the team, whereas TMM structure is represented by the reference between this shared knowledge and individual team members who are believed to hold specific vocational competencies. Looking at the example TMM-TM depicted in Figure 6, TMM content is represented by the categories inside the boxes, indicating concepts of vocational competence for which identical codings between team members were given, whereas TMM structure is represented by the connecting lines between these categories and individual team members.

Four TMM-TM indices corresponding to the four main categories of occupational, social, meta, and personal competence were calculated for each team on basis of the number of identical codings between team members with respect to concepts within the respective main category. The calculation is described in four steps. Firstly, identical codings between team members relating to a specific person were counted. Identical codings between team members were given if statements of at least two different team members about a specific person were coded in the same category. The number of identical codings equals the number of statements from different team members that are coded in the same category. The resulting index, $IC_{ij}$, is the number of identical codings referring to individual *i* in team *j*.

Secondly, $IC_{ij}$ was divided by the number of persons making statements about individual *i* in team *j*, which is the number of participating members of team *j* minus one ($n_j$ - 1). The resulting index, $ICa_{ij}$, is the average number of identical codings referring to person *i* in team *j*. It is interpreted as an indicator for the amount of TMM knowledge about the competencies of a team member that is on average held by her/his teammates. By setting the number of identical codings referring to a person in relation to the number of persons making statements about that person, $ICa_{ij}$ corrects for variations due to varying team size.

$$ICa_{ij} = \frac{IC_{ij}}{n_j - 1}$$

Thirdly, as TMM-TM is a group level phenomenon, $TMM\text{-}TM_j$, indicating the amount of common TMM-TM knowledge about the average person in team *j* that is on average held by members of that team, is calculated on team-level as the group mean of $ICa_{ij}$-values.

$$TMM\text{-}TM_j = \frac{1}{n_j} \sum_{i=1}^{n_j} ICa_{ij}$$

$TMM\text{-}TM_j$ mirrors the amount of common TMM-TM knowledge in team *j* by indicating how much TMM-TM knowledge with respect to the average team member is on average held in common by his/her teammates.

Fourthly, to gain more fine grained information about the content of shared knowledge held in the TMM-TM, $TMM\text{-}TM_j$ was split into four sub-indices relating to the four main areas of vocational competence. Only identical codings within the respective main area of competence were counted with respect to the calculation of each sub index. Subsequently, $TMM\text{-}TM_j$ values were calculated separately for identical codings in the areas of occupational, social, meta and personal competence. This procedure yielded the following

four indices for each team representing TMM-TM with respect to the four main areas of vocational competence: *TMM-OC$_j$* (occupational competencies), *TMM-SC$_j$* (social competencies), *TMM-MC$_j$* (meta competencies), and *TMM-PC$_j$* (personal competencies).

#### 4.2.2.2. Team performance

Team performance with respect to team effectiveness, team efficiency, and team innovativeness was measured using Likert-type scales by Van Woerkom and Croon (2009). Team performance was rated by team supervisors. It was assumed that supervisors are qualified to make reliable assessments of team performance as they are recipients of the team's work output (cf. Edmondson, 1999; Van der Vegt & Bunderson, 2005; Van Woerkom & Croon, 2009). Items were translated from Dutch to German and, in order to ensure accurate translation, back from German to Dutch. The response scale was ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Data from supervisors of 63 teams were available for testing the scales with respect to reliability and validity.

Conducting an EFA, Van Woerkom and Croon (2009) found support for the distinction of the three team performance dimensions of effectiveness, efficiency, and innovativeness. To assess whether this distinction fits the data of this study, CFA was carried out using maximum likelihood estimates with robust standard errors (MLR), which are robust with respect to non-normality of the data (Christ & Schlüter, 2012; Muthén & Muthén, 2010). This was necessary since Kolmogorov-Smirnov and Shapiro-Wilk normality tests indicated that normality is not given with respect to the variables in the model. Model fit and factor loadings were evaluated according to the criteria for conducting a CFA indicated above (see 4.2.1). Building on the results of the EFA conducted by Van Woerkom and Croon (2009), the initial model included 16 items referring to three factors, with eight items referring to effectiveness, four items referring to efficiency, and four items referring to innovativeness. Model fit of this initial model was not acceptable ($\chi^2$ = 138.85, *df* = 101, $p < .01$; CFI = 0.91; TLI = 0.90; SRMR = 0.085; RMSEA = 0.077). Two items from the team effectiveness scale were dropped because of insufficient factor loadings of $\lambda > .45$. One item from the innovativeness scale was dropped because of high modification indices. After dropping these items, model fit ($\chi^2$ = 64.78, *df* = 62, $p > .05$; CFI = 0.99; TLI = 0.99; SRMR = 0.056; RMSEA = 0.027) as well as factor loadings (effectiveness, .65 - .83; efficiency, .54 - .85; innovativeness, .73 - .83) were good. The resulting scales consist of six items for team effectiveness, for example "The team achieves its goals", four items for team efficiency, for example "The team spends the available time well", and three items for team innovativeness,

for example “The team develops new and improved ways of working” (see Appendix A.1. for full scales). Cronbach’s alpha values indicated good internal consistency of the three scales (team effectiveness, α = .87; team efficiency, α = .80; team innovativeness, α = .83).

In addition, team member ratings were applied for the measurement of team innovativeness, as team members have direct insight into their daily innovative performance. Accordingly, Griffin, Neal, and Parker (2007) showed that team members are better able than supervisors to differentiate between different dimensions of their performance while supervisors are likely to allocate more global performance ratings. Team member ratings of team innovativeness were gathered with the team innovativeness scale by Van Woerkom and Croon (2009). The scale consists of four items. Participants were instructed to refer the content of the questions to achievements of their team as a whole. Example items are “Our team develops new and improved ways of working” and “Our team develops new products or services”. The response scale was ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The full sample of $n_1$ = 359 members of $N_1$ = 75 teams was available for testing the reliability of the scale. Cronbach’s alpha indicated satisfactory internal consistency (α = .81).

### 4.2.3. Interpersonal context beliefs

All interpersonal context variables were measured with Likert-type scales ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), assessing team members’ perceptions regarding the interpersonal context of their team. The full sample of $n_1$=359 members of $N_1$=75 teams was available for testing the reliability of the scales.

Safe team climate was measured with the safe team climate scale from Bauer (2008, safe team climate – trust). The scale consists of 10 items. Example items are “If someone in the team has made a mistake, she or he can ask other team members for advice how to proceed” and “While working in this team, there’s a trustful relationship among colleagues” (see Appendix A.1. for full scales). Cronbach’s alpha for the scale was good (α = .90).

Task interdependence was measured with three items from Rupprecht (2014) and three self developed items. Example items are “In order to succeed in handling tasks within the project it is necessary that all team members do a good job” and “In order to succeed in handling tasks within the project I must collaborate closely with the people in my team”. Participants were instructed to interpret the term “project” in these questions as a synonym for the common work task of their team. Cronbach’s alpha confirmed the internal consistency of the scale (α = .77).

Team expert roles were measured with a newly developed scale consisting of four items based on Huang (2009). The items resemble the notion of strong team expert roles. Example items are "In our team, the individual team members possess different expert knowledge that is relevant to the common project" and "In our team, individual team members are responsible for different areas of expertise in the project". As for the items measuring task interdependence, participants were instructed to interpret the term "project" as a synonym for the common work task of their team. The internal consistency of the scale was satisfactory (α = .79).

### 4.2.4. Transformational leadership

Transformational leadership was measured with the global transformational leadership scale (GTL) by Carless et al. (2000). Based on theoretical dimensions of the construct, as reviewed by Podsakoff et al. (1990), Carless et al (2000) identified seven key behaviors that characterize the transformational leader: She or he "(1) communicates a vision, (2) develops staff, (3) provides support, (4) empowers staff, (5) is innovative, (6) leads by example, and (7) is charismatic" (p. 390). The GTL consists of seven items that are based upon these key behaviors. Example items are "Our team leader fosters trust, involvement and cooperation among team members" (empowerment) and "Our team leader encourages thinking about problems in new ways and questions assumptions" (innovative thinking) (see Appendix A.1. for all items). Answers were given on a 5-point Likert-type scale ranging from *strongly disagree* to *strongly agree*. The sample of $n_2$ = 184 members of $N_2$ = 37 teams was available for testing the reliability of the scale. Cronbach's alpha indicated high internal consistency (α = .93).

### 4.2.5. Control variables

Team size was included as a control variable in the investigation of Research Questions 1-3, as it may affect team learning activities, team innovativeness, and TMM-TM (see 3.1.4., 3.2.3., 3.3.3.). Information about team size was gathered from individual team members. Team members were asked to answer the following question: "How many persons does your team consist of?"

Team tenure, the amount of time the team already exists, was included as a control variable in the investigation of Research Questions 1, since it may affect basic reflection and team process reflection (see 3.1.4.). Information about team tenure in months was gathered from individual team members applying the following question: "How many months does your team already exist?"

The organizational type with respect to an organization`s profit orientation was included as a control variable in the investigation of Research Question 2, as it may affect team innovativeness (see 3.2.3.). Information about the organizational type was gathered from an experienced team member (preferably and mostly the team leader) applying the following question: "Which organizational type applies to the organization of your team?" Respondents could choose between the following two options to answer the question: "profit organization"; "non-profit organization".

Teamwork time, the average amount of weekly time team members currently spend working together on the common task, was included as a control variable in the investigation of Research Question 3, as it may affect TMM-TM (see 3.3.3.). Information about the average weekly teamwork time in hours was gathered from individual team members applying the following question: "How many hours per week are you currently working on average in the team on the common task?"

In addition, it was checked whether team members perceived their common task to be complex, unstructured, and non-routine. Applying two scales adapted from Morgeson & Humphrey (2006), team members rated their team's task with respect to *information processing*, measuring the degree to which the task requires team members to process and integrate widespread information, and *problem solving*, measuring the degree to which the task requires unique ideas or solutions to problems. Example items for information processing are: "The teamwork requires that we analyse a lot of information", "The teamwork requires that we engage in a large amount of thinking". Example items for problem solving are: "The teamwork requires the solving of problems that have no obvious correct answer", "The teamwork encompasses the solving of problems we have not encountered before". Answers were given on a 5-point Likert-type scale ranging from *strongly disagree* to *strongly agree*. The control variables of information processing and problem solving were added to the questionnaire after the survey had already been started. Therefore, ratings of these scales are not available from all study participants. However, data is available for the majority of respondents of 227 participants from 44 teams. Cronbach's alpha confirmed the internal consistency of both scales (information processing, $\alpha = .80$; problem solving, $\alpha = .75$). Descriptive statistics confirmed that on average team members perceived their common task to be complex regarding information processing ($M = 4.39$, $SD = .64$) and problem solving ($M = 4.25$, $SD = .69$).

Cronbach's alpha-coefficients for all variables and the respectively available data basis for testing the scales are summed up in Table 6.

Table 6

*Cronbach's Alpha-Coefficients and Data Basis of Study Variables*

| Variable | α-coefficient | Data basis |
|---|---|---|
| Knowledge sharing | .86 | $n_1$=359 individuals; $N_1$=75 teams |
| Task reflection | .76 | $n_1$=359 individuals; $N_1$=75 teams |
| Basic reflection | .79 | $n_1$=359 individuals; $N_1$=75 teams |
| Team process reflection | .79 | $n_1$=359 individuals; $N_1$=75 teams |
| Team reflection (unidimensional) | .89 | $n_1$=359 individuals; $N_1$=75 teams |
| Storage and retrieval | .71 | $n_1$=359 individuals; $N_1$=75 teams |
| Team effectiveness (supervisor ratings) | .87 | Supervisor ratings for 63 teams |
| Team efficiency (supervisor ratings) | .80 | Supervisor ratings for 63 teams |
| Team innovativeness (supervisor ratings) | .83 | Supervisor ratings for 63 teams |
| Team innovativeness (team member ratings) | .81 | $n_1$=359 individuals; $N_1$=75 teams |
| Safe team climate | .90 | $n_1$=359 individuals; $N_1$=75 teams |
| Task interdependence | .77 | $n_1$=359 individuals; $N_1$=75 teams |
| Team expert roles | .79 | $n_1$=359 individuals; $N_1$=75 teams |
| Transformational leadership | .93 | $n_2$=184 individuals; $N_2$=37 teams |
| Information processing | .80 | 227 individuals, 44 teams |
| Problem solving | .75 | 227 individuals, 44 teams |

## 4.3. Research Question 1: Team learning processes and the interpersonal context

The relations between the variables of the study were investigated with the aim to answer the four formulated research questions. The variables included in the investigation of Research Question 1 (What beliefs about the team's interpersonal context are related to which team learning activity?) are displayed in Table 7. The full sample of $n_1$=359 members of $N_1$=75 teams was available for all calculations with respect to Research Question 1 (see 4.1.).

Table 7

*Variables Included in the Investigation of Research Question 1*

| Variable name | Variable type |
|---|---|
| Team size | CV |
| Team tenure | CV |
| Safe team climate | IV – interpersonal context |
| Task interdependence | IV– interpersonal context |
| Team expert roles | IV– interpersonal context |
| Knowledge sharing | DV – team learning activity |
| Task reflection | DV – team learning activity |
| Basic reflection | DV – team learning activity |
| Team process reflection | DV – team learning activity |
| Storage and retrieval | DV – team learning activity |

*Note.* CV = control variable, IV = independent variable, DV = dependent variable.

### 4.3.1. Analyses

#### 4.3.1.1. Level of analysis – Data aggregation

All variables are theoretically meaningful at the team-level. Therefore, data gathered from individual team members were aggregated to the team-level by calculating team means out of individual team member scores. Data aggregation is justified if members of same teams are sufficiently homogenous in their scores. This requirement was tested by calculating the $r_{wg}$ index for interrater agreement and the intraclass correlation coefficient *ICC(1)* (LeBreton & Senter, 2008). Mean $r_{wg}$ values of variables in the study ranged from .72 to .91. All values exceeded the level of .70, which is usually taken as cut-off value for aggregation (LeBreton & Senter, 2008). Calculation of mean $r_{wg}$ values with respect to team size and team tenure was

not sensible, as these variables were measured using an open answer format and $r_{wg}$ can only be applied with variables measured on a defined answer scale. *ICC(1)* values for variables in this study ranged from .14 to .80. All values exceeded the level of .12, which Schippers et al. (2007) indicate as a threshold for aggregation. In addition, *ICC(2)* was calculated to assess the reliability of team means (LeBreton & Senter, 2008). *ICC(2)* values ranged from .49 to .95. As *ICC(2)* depends on group size and teams in the sample were relatively small, it is not surprising that some values were not particularly high. However, all values were close to or exceeded the threshold of .50, which indicates a tolerable value (Klein et al., 2000). Moreover, values are comparable to those reported in the literature on organizational small groups (e.g. Nijstad et al, 2014; Van der Vegt & Bunderson, 2005; Van Woerkom & Van Engen, 2009). Overall, these statistics justify aggregation of the data to the team-level. *ICC*s and mean $r_{wg}$ values are displayed in Table 8.

Table 8

*Statistics for the Justification of Data Aggregation (Research Question 1)*

| Variable | *ICC(1)* | *ICC(2)* | Mean $r_{wg}$ |
|---|---|---|---|
| Team size | .80 | .95 | -- |
| Team tenure | .64 | .89 | -- |
| Safe team climate | .42 | .78 | .91 |
| Task interdependence | .29 | .66 | .88 |
| Team expert roles | .45 | .80 | .81 |
| Knowledge sharing | .26 | .62 | .90 |
| Task reflection | .23 | .59 | .87 |
| Basic reflection | .14 | .49 | .78 |
| Team process reflection | .17 | .54 | .72 |
| Storage and retrieval | .35 | .72 | .80 |

*Note.* $N_1$ = 75 teams, $n_1$ = 359 individuals.

#### 4.3.1.2. Analyses for hypothesis testing

To test for the expected relationships between team learning activities, interpersonal context variables and control variables at the team-level, path modelling with aggregated data was performed using the software *Mplus 6*. Before hypothesis testing, it was checked whether modeling might be affected by multicollinearity. Inspection of correlations between predictors revealed that task interdependence is significantly correlated with safe team climate ($r = .37$, $p < .01$) and team expert roles ($r = .36$, $p < .01$) (see Table 9). However, variance inflation factors (VIF) are relatively small for all predictors, varying between 1.06 and 1.39. Therefore, model parameter estimates are not expected to be biased because of multicollinearity (see Von Eye & Schuster, 1998). Path Model 1 was formulated in accordance with Hypotheses 1-14 and expectations with respect to control variables. Covariance between residuals of dependent variables was accepted in the model. This is reasonable as past research has shown different team learning activities to be closely related (e. g. Savelsbergh et al., 2009; Schippers et al, 2007; Van den Bossche et al., 2006). Modeling was conducted using robust maximum likelihood estimates (MLR, Muthén & Muthén, 2010), since normal distribution was not given with respect to the majority of variables in the model (see Appendix A.3.). Fit indices indicated a good model fit ($\chi^2 = 3.00$, $df = 5$, $p = .70$; CFI = 1.00; TLI = 1.07; SRMR = 0.023; RMSEA = 0.000). An alternative model was tested fixing the residual covariances of dependent variables to zero. As the MLR estimator was used, the difference between $\chi^2$-values of the models was corrected applying the procedure developed by Satorra and Bentler (2001), as described by Christ and Schlüter (2012). The model fit of the alternative model was not acceptable and significantly worse than for the initial model ($\chi^2 = 56.91$, $df = 15$, $p < .01$; CFI = 0.81; TLI = 0.54; SRMR = 0.071; RMSEA = 0.193; $\chi^2_{diff} = 48.88$, $df = 10$, $p < .001$). Thus, hypotheses were tested using the initial model (Path Model 1).

### 4.3.2. Results

Means, standard deviations, and Pearson correlations with respect to aggregated variables included in the investigation of Research Question 1 are shown in Table 9. Path Model 1 is depicted in Figure 7. Standardized model estimates are displayed in Table 10.

Hypotheses 1 to 4 state positive relations between a safe team climate and the team learning activities of knowledge sharing, task reflection, basic reflection and team process reflection. Path Model 1 showed significant positive paths between safe team climate and knowledge sharing ($\beta = .63$, $p < .01$), task reflection ($\beta = .46$, $p < .01$), and team process reflection ($\beta = .22$, $p < .05$). No significant path was found between safe team climate and

basic reflection. Thus, Hypotheses 1, 2, and 4 are supported by the data, whereas Hypothesis 3 is not. In accordance with the expectation that safe team climate and storage and retrieval are not related, no significant correlation was found between these two variables. In Path Model 1, the path coefficient between safe team climate and storage and retrieval was fixed to zero. To further validate the assumption that safe team climate and storage and retrieval are not related, an alternative model freely estimating the path between these two variables was tested (Path Model 1.1, see Appendix A.6.). No significant path between safe team climate and storage and retrieval was found. Furthermore, chi-square difference testing showed no significant improve in model fit for the alternative model ($\chi^2_{diff} = .35$, $df = 1$, $p > .05$).

Hypotheses 5 to 9 state positive relations between task interdependence and all investigated team learning activities. These hypotheses are confirmed by the data (knowledge sharing, $\beta = .18$, $p < .05$; task reflection, $\beta = .30$, $p < .01$; basic reflection, $\beta = .35$, $p < .01$; team process reflection, $\beta = .34$, $p < .01$; storage and retrieval, $\beta = .42$, $p < .01$).

Supporting Hypotheses 10, 11, and 13, significant negative relations were found between team expert roles and the team learning activities of knowledge sharing ($\beta = -.15$, $p < .05$), task reflection ($\beta = -.23$, $p < .05$), and team process reflection ($\beta = -.23$, $p < .05$). However, Hypotheses 12 and 14 are not supported by the data since no significant positive relation was found between team expert roles and basic reflection, and no significant negative relation was found between team expert roles and storage and retrieval.

Control variables were incorporated in the model according to the formulated assumptions regarding their impact on team learning activities. Team size was assumed to negatively affect knowledge sharing, task reflection, basic reflection and team process reflection. Significant negative effects were found with respect to knowledge sharing ($\beta = -.30$, $p < .01$) and basic reflection ($\beta = -.21$, $p < .05$). Task reflection and team process reflection were not affected by team size. Team tenure was assumed to positively affect basic reflection and team process reflection. However, no significant effects regarding team tenure were found in Path Model 1.

Table 9

*Descriptive Statistics and Pearson Correlations (Research Question 1)*

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Team size | 5.63 | 2.50 | | | | | | | | | |
| 2. Team tenure | 34.85 | 43.23 | .12 | | | | | | | | |
| 3. Safe team climate | 4.40 | .46 | -.20 | -.16 | | | | | | | |
| 4. Task interdependence | 4.11 | .42 | -.16 | -.17 | .37** | | | | | | |
| 5. Team expert roles | 4.08 | .65 | -.01 | .05 | .04 | .36** | | | | | |
| 6. Knowledge sharing | 4.33 | .35 | -.45** | -.13 | .76** | .41** | -.06 | | | | |
| 7. Task reflection | 4.22 | .39 | -.30** | -.17 | .59** | .41** | -.11 | .72** | | | |
| 8. Basic reflection | 3.85 | .40 | -.27* | -.02 | .29* | .47** | .27* | .42** | .42** | | |
| 9. Team process reflection | 3.09 | .50 | -.16 | .01 | .33** | .34** | -.09 | .51** | .56** | .47** | |
| 10. Storage and retrieval | 3.98 | .57 | .03 | -.01 | .10 | .41** | .12 | .19 | .13 | .32** | .34** |

*Note.* $N_1$ = 75 teams. Response scale for variables 3-5 is ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), response scale for variables 6-10 is ranging from 1 (*never*) to 5 (*very often*).

* $p < .05$, ** $p < .01$, two-tailed.

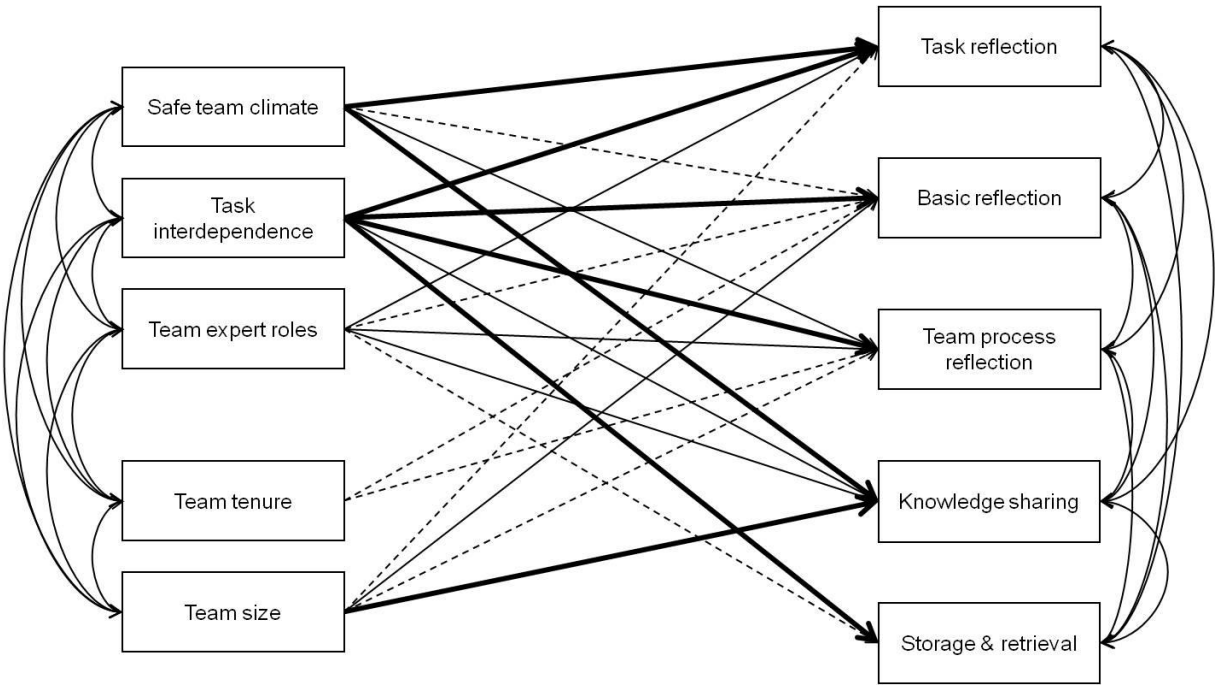


*Figure 7.* Path Model 1: Team-level path model of the relations between team learning activities, interpersonal context variables, and control variables. Bold arrow path ≙ $p < .01$, normal arrow path ≙ $p < .05$, dashed arrow path ≙ $p > .05$ (not significant).

Table 10

*Model Estimates of Path Model 1*

| Predictors | Team learning activities | | | | |
|---|---|---|---|---|---|
| | Knowledge sharing | Task reflection | Basic reflection | Team process reflection | Storage and retrieval |
| Team size | -.30** | -.17 | -.21* | -.10 | -- |
| Team tenure | -- | -- | .06 | .10 | -- |
| Safe team climate | .63** | .46** | .13 | .22* | -- |
| Task interdependence | .18* | .30** | .35** | .34** | .42** |
| Team expert roles | -.15* | -.23* | .13 | -.23* | -.03 |

*Note.* $N_1 = 75$ teams. Standardized path coefficients are reported. Model fit: $\chi 2 = 3.00$, $df = 5$, $p = .70$; CFI = 1.00; TLI = 1.07; SRMR = 0.023; RMSEA = 0.000.

* $p > .05$, ** $p > .01$, two-tailed.

## 4.4. Research Question 2: Team reflection linking transformational leadership and team innovativeness

The variables included in the investigation of Research Question 2 (What is the mediating role of team reflection in the relation between transformational leadership and team innovativeness?) are displayed in Table 11. The sample of $n_2 = 184$ members of $N_2 = 37$ teams was available for calculations with respect to Research Question 2. Team supervisor ratings of team innovativeness were available for all 37 teams (see 4.1.).

Table 11

*Variables Included in the Investigation of Research Question 2*

| Variable name | Variable type |
|---|---|
| Team size | CV |
| Organizational type | CV |
| Transformational leadership | IV/Moderator |
| Team reflection | Mediator – team learning activity |
| Safe team climate | Moderator – interpersonal context |
| Team innovativeness-TMR[1] | DV – team performance |
| Team innovativeness-TSR[1] | DV – team performance |

*Note.* CV = control variable, IV = independent variable, DV = dependent variable.
[1] TMR = Team member ratings of team innovativeness, TSR = Team supervisor ratings of team innovativeness.

### 4.4.1. Analyses

#### 4.4.1.1. Level of analysis – Data aggregation

All variables are theoretically meaningful at the team-level. Therefore, data gathered from individual team members were aggregated to the team-level by calculating team means out of individual team member scores. To justify data aggregation, the $r_{wg}$ index for interrater agreement and the intraclass correlation coefficient *ICC(1)* were calculated (see 4.3.1.1.). Mean $r_{wg}$ values ranged from .76 to .88. All values exceeded the level of .70 (LeBreton & Senter, 2008). Calculation of the mean $r_{wg}$ value with respect to team size was not sensible, as this variable was measured using an open answer format (see 4.3.1.1.). *ICC(1)* values range from .14 to .72. All values exceeded the threshold of .12 (Schippers et al., 2007). Mean $r_{wg}$

and *ICC(1)* values demonstrate that the scores of members of same teams are sufficiently homogenous to justify data aggregation. *ICC(2)* values, indicating the reliability of team means (LeBreton & Senter, 2008), ranged from .44 to .95. As *ICC(2)* depends on group size and teams in the sample were relatively small, it is not surprising that some values were not particularly high. However, all values but one (team reflection, *ICC(2)* =.44) exceeded the threshold of .50, (Klein et al., 2000). Moreover, values were comparable to those reported in the literature on organizational small groups (e.g. Nijstad et al, 2014; Van der Vegt & Bunderson, 2005; Van Woerkom & Van Engen, 2009). Overall, these statistics justify aggregation of the data to the team-level. *ICC*s and mean $r_{wg}$ values are displayed in Table 12.

Table 12

*Statistics for the Justification of Data Aggregation (Research Question 2)*

| Variable | *ICC(1)* | *ICC(2)* | Mean $r_{wg}$ |
|---|---|---|---|
| Team size | .72 | .93 | -- |
| Safe team climate | .49 | .83 | .88 |
| Transformational leadership | .21 | .56 | .76 |
| Team reflection | .14 | .44 | .81 |
| Team innovativeness-TMR[1] | .23 | .59 | .79 |

*Note.* $N_2$ = 37 teams, $n_2$ = 184 individuals.

[1] TMR = Team member ratings of team innovativeness.

### 4.4.1.2. Analyses for hypothesis testing

The developed unidimensional measure of team reflection was applied for the investigation of Research Question 2 (see 4.2.1.) since the associated hypotheses (Hypotheses 15-17) are formulated with respect to the overarching construct of team reflection (see 3.2.). To test for the hypothesized mediation and moderated mediations, the approach described by Hayes (2013) was carried out using the PROCESS (version 2.13) macro for SPSS. As standard normal distribution cannot be assumed for the sampling distribution of indirect effects, bootstrapping was applied for hypothesis testing (Hayes, 2013). Bias corrected bootstrap confidence intervals were calculated with 10,000 bootstrap samples. Positive indirect effects were assumed to be significant if the 95% bootstrap confidence interval was entirely above zero (Hayes, 2013). Variables used in the construction of products were mean centered prior

to estimation (Hayes, 2013). For probing interactions, conditional and conditional indirect effects were estimated at the sample mean of the moderator as well as at the mean plus and minus one standard deviation, resembling indirect effects at "low", "moderate", and "high" levels of the moderator, relative to the sample. The index of moderated mediation (*IMM*) was used to test for the significance of conditional indirect effects (Hayes, 2015). To illustrate moderation effects, interactions were plotted as described by Aiken and West (1991) (see Figures 8 and 9). Covariates were set to their sample mean for the calculation of values for plotting (Hayes, 2013).

Hypotheses were tested for team member ratings (TMR) as well as for team supervisor ratings (TSR) of team innovativeness applying sequential multiple regression analyses. Sequential analyses were applied in order to investigate the improvement in explanatory power of the regression models due to adding the respective interaction term (Sedlmeier & Renkewitz, 2013). Dependent variables and controls were entered in step one (Models 1 and 4), whereas the respective interaction term was entered in step two (Models 2, 3, 5, and 6). Six regression models were tested corresponding to the formulated research models (Research Models 2, 3, and 4). The aggregated variable of team innovativeness-TMR was investigated as dependent variable in Regression Models 1-3. In Regression Models 4-6, team innovativeness-TSR was investigated as dependent variable. Except for the dependent variable, Regression Models 4-6 were identical to Regression Models 1-3. Mediation through team reflection was investigated in Regression Models 1 and 4. Adding the interaction between transformational leadership and team reflection, moderated mediation, with respect to moderation by transformational leadership, was tested in Regression Models 2 and 5. Adding the interaction between safe team climate and team reflection, moderated mediation, with respect to moderation by safe team climate, was tested in Regression Models 3 and 6.

The two major model assumptions of independence of error terms and homoscedasticity (cf. Van der Vegt & Bunderson, 2005) were evaluated for all six regression models. The model assumption of independence of error terms was evaluated by means of the Durbin-Watson coefficient, whereas values between 1.5 and 2.5 can be interpreted as an indicator that no interfering autocorrelation is given (Rudolf & Müller, 2004). Durbin-Watson coefficients ranged from 1.66 to 1.99 and, thus, were acceptable for all six regression models (see Appendix A.4.1.). To test the model assumption of homoscedasticity, scatterplots of residuals as function of predicted values were evaluated (Rudolf & Müller, 2004; Wentura & Pospeschill, 2015). No conspicuous patterns indicating heteroscedasticity were detected (see Appendix A.4.2.). In addition, VIFs were applied in order to check for multicollinearity. VIFs

ranged from 1.14 to 1.88, indicating that multicollinearity is not a major concern (see Von Eye & Schuster, 1998). Furthermore, to examine the stability of findings, models were tested with and without control variables and the additional covariate of safe team climate (cf. Nijstad et al., 2014). Speaking in favor of stability, no deviant results were found with respect to the formulated hypotheses (see Appendix A.5.).

### 4.4.2. Results

Descriptive statistics and Pearson correlations are presented in Table 13. Regression models testing for indirect and conditional indirect effects on team innovativeness-TMR are presented in Table 14. Regression models testing for indirect and conditional indirect effects on team innovativeness-TSR are presented in Table 15. Interactions with respect to team innovativeness-TMR as dependent variable are plotted in Figure 8. Interactions with respect to team innovativeness-TSR as dependent variable are plotted in Figure 9.

Supporting Hypothesis 15, Regression Model 1 showed a significant positive mediation effect of team reflection between transformational leadership and team innovativeness-TMR (b = .21, BC 95% CI 0.04-0.51). In contrast, no significant mediation effect of team reflection between transformational leadership and team innovativeness-TSR was found in Regression Model 4 (b = .19, BC 95% CI -0.06-0.57). Thus, mixed support is given with respect to Hypothesis 15. Whereas the hypothesis is confirmed with respect to team innovativeness-TMR, it is rejected with respect to team innovativeness-TSR.

In support for Hypothesis 16, a significant moderation effect of transformational leadership in the relation between team reflection and team innovativeness-TMR was found in Regression Model 2 (b = 1.14, $p < .01$). Testing the relation at different values of the moderator showed it to be significant at moderate (b = .60, $p < .01$) and high (b = 1.19, $p < .01$) levels of transformational leadership, but not at low level. Adding the interaction term significantly improves the explained variance in Regression Model 2, as compared to Regression Model 1 ($\Delta R^2 = .12$, $p < .01$). Furthermore, Hypothesis 16 was confirmed by the *IMM* in Regression Model 2, showing that the indirect effect between transformational leadership and team innovativeness-TMR was significantly moderated by transformational leadership (*IMM* = .34, BC 95% CI 0.09-0.70). Testing the indirect effect at different values of the moderator indicated that it is significant at moderate (b = .18, BC 95% CI 0.05-0.40) and high (b = .35, BC 95% CI 0.11-0.65) levels of transformational leadership, but not at low level. In contrast, no support for Hypothesis 16 was found with respect to team innovativeness-TSR. Regression Model 5 showed no significant moderation effect of

transformational leadership in the relation between team reflection and team innovativeness-TSR (b = .80, $\Delta R^2$ = .02, p > .05). The conditional indirect effect, as indicated by the *IMM*, was not significant (b = .24, BC 95% CI -0.31-1.01). Thus, similar to Hypothesis 15, mixed support is given with respect to Hypothesis 16. The hypothesis is confirmed with respect to team innovativeness-TMR and rejected with respect to team innovativeness-TSR.

No support was found with respect to Hypothesis 17. Regression Model 3 showed that the moderation effect of safe team climate in the relation between team reflection and team innovativeness-TMR is in the hypothesized direction, but barely not significant (b = .76, $\Delta R^2$ = .04, p = .06). Speaking somewhat in favor of moderation, testing the relation at different values of the moderator showed it to be significant at moderate (b = .54, p < .05) and high (b = .96, p < .01) levels of safe team climate, but not at low level. However, the conditional indirect effect, as indicated by the *IMM*, is not significant (b = .30, BC 95% CI -0.14-0.70). Thus, no support for Hypothesis 17 is given by Regression Model 3. Furthermore, no support for Hypothesis 17 was found with respect to team innovativeness-TSR. Regression Model 6 showed no significant moderation effect of safe team climate in the relation between team reflection and team innovativeness-TSR (b = .39, $\Delta R^2$ = .00, p > .05). The conditional indirect effect, as indicated by the *IMM*, is not significant (b = .15, BC 95% CI -0.73-0.97).

With respect to the investigated control variables, the organizational type significantly positively predicted team innovativeness-TMR throughout Regression Models 1-3. Thus, team members employed by profit organizations rated team innovativeness higher than those employed by non-profit organizations. No significant effect of team size on team innovativeness-TMR was found. Team innovativeness-TSR was not affected by control variables throughout Regression Models 4-6.

Table 13

*Descriptive Statistics and Pearson Correlations (Research Question 2)*

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| 1. Team size | 6.02 | 2.25 | | | | | | |
| 2. Organizational type[1] | .49 | .51 | .12 | | | | | |
| 3. Transformational leadership | 4.06 | .51 | .05 | .00 | | | | |
| 4. Safe team climate | 4.34 | .55 | -.11 | .26 | .48** | | | |
| 5. Team reflection | 3.62 | .34 | -.25 | .01 | .58** | .52** | | |
| 6. Team innovativeness-TMR[2] | 3.62 | .46 | -.29 | .35* | .42** | .52** | .65** | |
| 7. Team innovativeness-TSR[2] | 3.64 | .77 | .18 | .04 | .43** | .10 | .33* | .44** |

*Note.* $N_2$ = 37 teams, $n_2$ = 184 individuals. Response scale for variables 3, 4, 6, and 7 is ranging from 1 (*strongly disagree*) to 5 (*strongly agree*); response scale for variable 5 is ranging from 1 (*never*) to 5 (*very often*).

[1]non-profit = 0, profit = 1. [2] TMR = Team member ratings of team innovativeness, TSR = Team supervisor ratings of team innovativeness.

* $p < .05$, ** $p < .01$, two-tailed.

Table 14

*Regression Models Testing for Indirect and Conditional Indirect Effects on Team Innovativeness-TMR*

| Predictor | | Regression Model 1: Mediation | Regression Model 2: Moderated mediation (TL) | Regression Model 3: Moderated mediation (STC) |
|---|---|---|---|---|
| Team Size | | -.04 | -.04† | -.04† |
| Organizational Type | | .31** | .29** | .38** |
| Team Reflection (TR) | | .71** | .60** | .54* |
| Transformational Leadership (TL) | | .07 | .11 | .13 |
| Safe Team Climate (STC) | | .08 | .17 | .19 |
| TL x TR | | | 1.14** | |
| STC x TR | | | | .76† |
| Conditional effect at values of the moderator | *M*-1*SD* | | .02 | .12 |
| | *M* | | .60** | .54* |
| | *M*+1*SD* | | 1.19** | .96** |
| $R^2$ | | .61** | .73** | .65** |
| $\Delta R^2$ due to interaction | | | .12** | .04† |
| Indirect effect/ 95% bootstrap CI[1] | | .21/0.04-0.51 | | |
| Conditional indirect effect at values of the moderator/95% bootstrap CI | *M*-1*SD* | | .01/-0.16-0.21 | .05/-0.24-0.40 |
| | *M* | | .18/0.05-0.40 | .21/0.00-0.43 |
| | *M*+1*SD* | | .35/0.11-0.65 | .37/0.10-0.73 |
| Index of Moderated Mediation (*IMM*) / 95% CI | | | .34/0.09-0.70 | .30/-0.14-0.70 |

*Note.* $N_2$ = 37 teams. Dependent variable: Team member ratings (TMR) of team innovativeness. Unstandardized regression coefficients are reported.

[1] Bias corrected bootstrap intervals; 10,000 bootstrap samples.

†p<.10, *p < .05, ** p < .01.

Table 15

*Regression Models Testing for Indirect and Conditional Indirect Effects on Team Innovativeness-TSR*

| Predictor | | Regression Model 4: Mediation | Regression Model 5: Moderated mediation (TL) | Regression Model 6: Moderated mediation (STC) |
|---|---|---|---|---|
| Team Size | | .07 | .07 | .06 |
| Organizational Type | | .10 | .09 | .14 |
| Team Reflection (TR) | | .64 | .57 | .55 |
| Transformational Leadership (TL) | | .55† | .58† | .58† |
| Safe Team Climate (STC) | | -.31 | -.25 | -.25 |
| TL x TR | | | .80 | |
| STC x TR | | | | .39 |
| Conditional effect at values of the moderator | *M*-1*SD* | | .16 | .33 |
| | *M* | | .57 | .55 |
| | *M*+1*SD* | | .97 | .77 |
| $R^2$ | | .27† | .29† | .27 |
| $\Delta R^2$ due to interaction | | | .02 | .00 |
| Indirect effect/ 95% bootstrap CI[1] | | .19/-0.06-0.57 | | |
| Conditional indirect effect at values of the moderator/95% bootstrap CI | *M*-1*SD* | | .05/-0.38-0.72 | .13/-0.54-0.94 |
| | *M* | | .17/-0.08-0.59 | .22/-0.22-0.63 |
| | *M*+1*SD* | | .29/-0.03-0.72 | .30/-0.15-0.84 |
| Index of Moderated Mediation (*IMM*) / 95% CI | | | .24/-0.31-1.01 | .15/-0.73-0.97 |

*Note.* $N_2$ = 37 teams. Dependent variable: Team supervisor ratings (TSR) of team innovativeness. Unstandardized regression coefficients are reported.

[1] Bias corrected bootstrap intervals; 10,000 bootstrap samples.

†p<.10, *p < .05, ** p < .01.

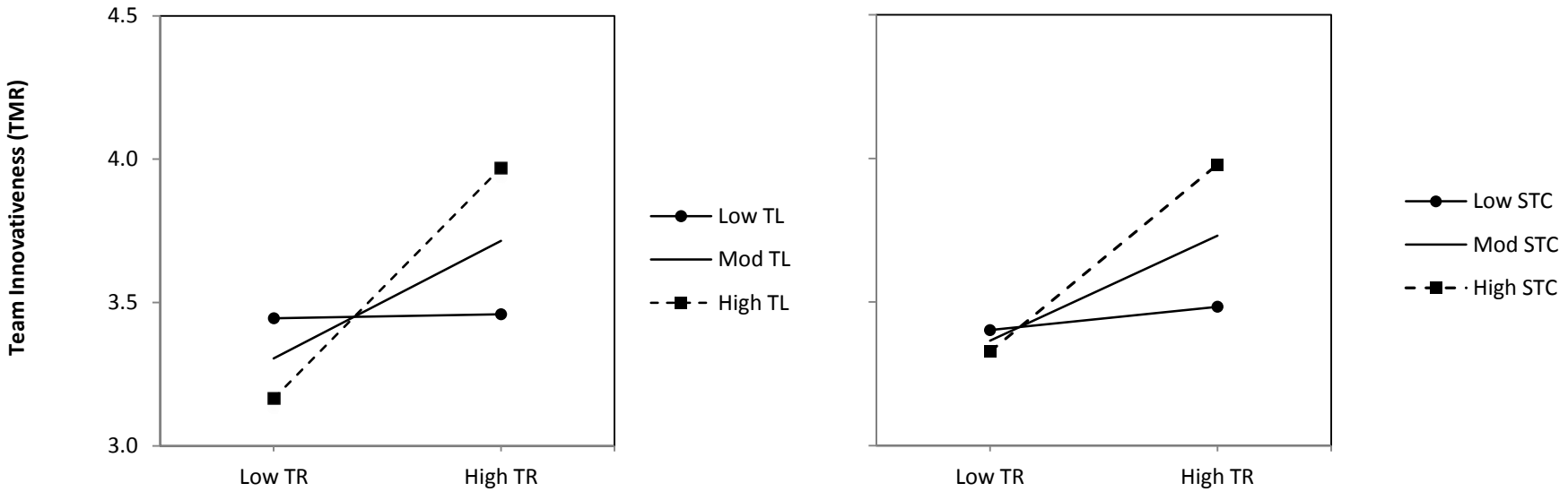


*Figure 8.* Interactions of team reflection (TR) with transformational leadership (TL) and safe team climate (STC) on team member ratings (TMR) of team innovativeness.

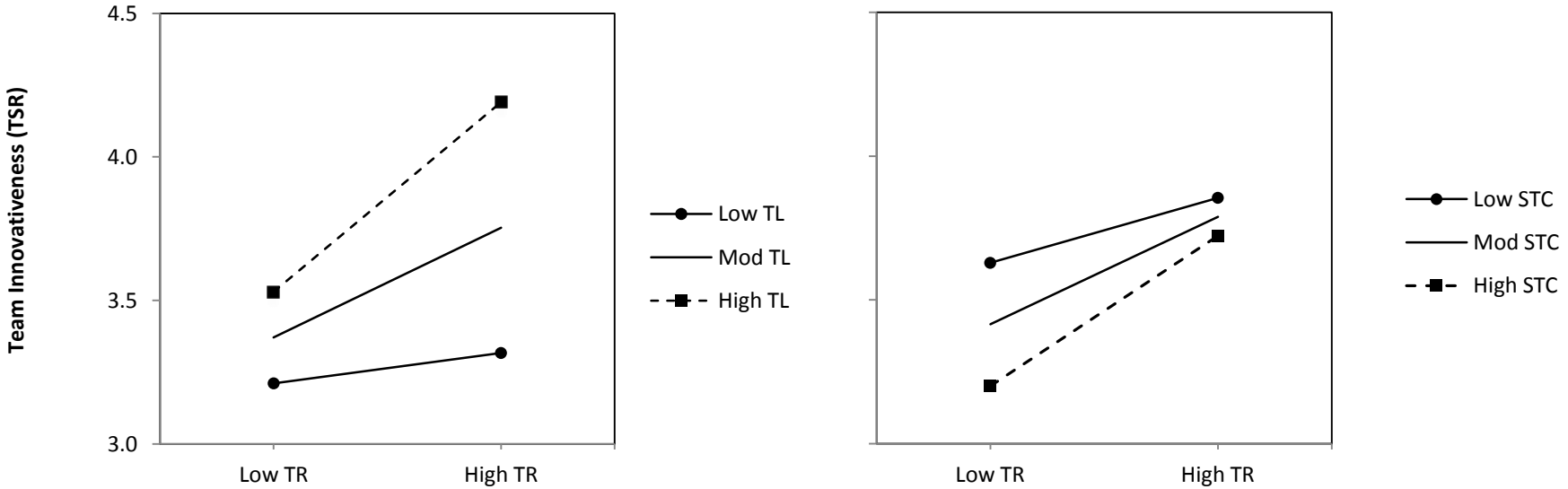


*Figure 9.* Interactions of team reflection (TR) with transformational leadership (TL) and safe team climate (STC) on team supervisor ratings (TSR) of team innovativeness.

## 4.5. Research Questions 3 and 4: Team performance, TMM-TM, and team learning activities

Research Questions 3 addresses the relationship of team learning activities with TMM-TM (Research Question 3: How are team learning activities related to TMM-TM?). Research Question 4 addresses the relationship of TMM-TM with team performance (Research Question 4: How is TMM-TM related to team performance?). The two research questions are investigated together in one analysis as TMM-TM is central in both research questions. Variables included in the investigation of Research Questions 3 and 4 are displayed in Table 16. The sample of $n_3$ = 304 members of $N_3$ = 63 teams was available for calculations with respect to Research Question 3. Calculations with respect to Research Question 4 are based on $N_4$ = 54 teams, whereas $N_4$ is a subsample of $N_3$ consisting of those teams for which team supervisor ratings were available (see 4.1.).

Table 16

*Variables Included in the Investigation of Research Questions 3 and 4*

| Variable name | Variable type |
|---|---|
| Team size | CV |
| Teamwork time | CV |
| Knowledge sharing | IV – team learning activity; Research Question 3 |
| Task reflection | IV – team learning activity; Research Question 3 |
| Basic reflection | IV – team learning activity; Research Question 3 |
| Team process reflection | IV – team learning activity; Research Question 3 |
| Storage and retrieval | IV – team learning activity; Research Question 3 |
| TMM-OC | DV – Research Question 3; IV – Research Question 4 |
| TMM-SC | DV – Research Question 3; IV – Research Question 4 |
| TMM-MC | DV – Research Question 3; IV – Research Question 4 |
| TMM-PC | DV – Research Question 3; IV – Research Question 4 |
| Effectiveness | DV – team performance; Research Question 4 |
| Efficiency | DV – team performance; Research Question 4 |
| Innovativeness | DV – team performance; Research Question 4 |

*Note.* CV = control variable, IV = independent variable, DV = dependent variable.

### 4.5.1. Analyses

All measured variables are theoretically meaningful at the team-level. TMM-TM and team performance were directly measured at the team-level, with one measurement per team for each variable. Team learning activities and control variables were measured at the individual level. One way to deal with this kind of data is to aggregate the information gathered from individuals to the team-level by calculating the team mean. However, this kind of data aggregation ignores the measurement precision within each team, which depends on team size and the degree of similarity of ratings within a team (Heck & Thomas, 2009). Therefore, a multilevel modelling approach was applied taking into account within-group measurement precision by decomposing manifest variables measured at the individual level into two uncorrelated latent variables separately representing variance of manifest variables at individual and team-level (Muthén & Muthén, 2010). Hypotheses were tested using path modelling at the team-level based on unbiased estimates of the between-teams covariance matrix. No modelling was conducted at the individual level, as independent and dependent variables are theoretically meaningful at the team-level and dependent variables, as measured at the team-level, have no variance at the individual level.

A requirement for performing data analysis at the team-level based on data gathered from individuals is the presence of considerable variance at the team-level (Bliese, 2000). This requirement was tested through evaluation of the intraclass correlation coefficient *ICC(1)*, which indicates the proportion of a variables' variance that lies between groups (Heck & Thomas, 2009). *ICC(1)* values ranged from .14 to .76 (see Table 17), confirming that modeling at the team-level is justified (Heck & Thomas, 2009).

Twolevel path modeling at the team-level applying robust maximum likelihood estimates was performed using the *Mplus 6* software package (Muthén & Muthén, 2010). To avoid multicollinearity, four separate models were formulated with respect to the investigated team learning activities, as these were highly correlated (see Table 17). Knowledge sharing was included in Path Model 2. Task reflection and storage and retrieval were entered together in Path Model 3, as these two variables were least correlated among team learning activities ($r = .10$, $p > .05$). Paths coefficients between storage and retrieval and TMM-TM variables were fixed to zero as no relations were expected. An alternative model was tested in which these parameters were freed. Basic reflection was included in Path Model 4. The path coefficient between basic reflection and TMM-OC was fixed to zero as no relation was expected. An alternative model was tested in which this parameter was freed. Team process reflection was entered in Path Model 5. Team performance variables, TMM variables, and control variables

were held constant throughout the four models. The path coefficient between TMM-SC and team innovativeness was fixed to zero as no relation was expected. An alternative model was tested, in which this parameter was freed. Covariance between residuals of the dependent variables of team performance was accepted in the model. This is reasonable as past research has shown different dimensions of team performance to be closely related (e.g. Bateman, Wilson, & Bingham, 2002; Cacioppe & Stace, 2009; Van Woerkom & Croon, 2009). Acceptable model fit was considered to be given if the chi-square Test was not significant and alternative fit indices met the indicated criteria (see 4.2.1.). Model fit was acceptable for all four models (Path Model 2: $\chi 2 = 16.35$, df = 16, p = .43; CFI = 1.00; TLI = 0.99; SRMR (between) = 0.080; RMSEA = 0.009; Path Model 3: $\chi 2 = 17.00$, df = 23, p = .81; CFI = 1.00; TLI = 1.16; SRMR (between) = 0.062; RMSEA = 0.000; Path Model 4: $\chi 2 = 16.51$, df = 17, p = .49; CFI = 1.00; TLI = 1.02; SRMR (between) = 0.075; RMSEA = 0.000; Path Model 5: $\chi 2 = 10.00$, df = 16, p = .87; CFI = 1.00; TLI = 1.20; SRMR (between) = 0.060; RMSEA = 0.000).

### 4.5.2. Results

Means, standard deviations, *ICC (1)* values and team-level correlations with respect to the variables included in the investigation of Research Questions 3 and 4 are shown in Table 17. Path Models 2-5 are depicted in Figures 10-13. Standardized model estimates for Path Models 2-5 are displayed in Table 18. Path coefficients between TMM and team performance variables are identical by two decimal places throughout Path Models 2-5. Therefore, separate modelling results are only reported with respect to the relations between TMM-TM variables and their predictors.

In support for Hypothesis 18, Path Model 2 showed significant positive relations between knowledge sharing and TMM-SC ($\beta = .51$, $p < .01$), TMM-MC ($\beta = .42$, $p < .01$), and TMM-PC ($\beta = .45$, $p < .05$). However, no significant relation between knowledge sharing and TMM-OC was found. Thus, partial support is given with respect to Hypothesis 18. The hypothesis is supported with respect to TMM-SC, TMM-MC, and TMM-PC, but not supported with respect to TMM-OC.

Likewise, partial support is given with respect to Hypothesis 19. In support for the hypothesis, Path Model 3 showed significant positive relations between task reflection and TMM-SC ($\beta = .43$, $p < .01$), TMM-MC ($\beta = .29$, $p < .05$), and TMM-PC ($\beta = .55$, $p < .01$). Concerning TMM-OC, no significant relation was found. Thus, Hypothesis 19 is supported with respect to TMM-SC, TMM-MC, and TMM-PC, but not supported with respect to TMM-

OC. Storage and retrieval was also included in Path Model 3, whereas path coefficients between storage and retrieval and TMM-TM variables were fixed to zero as no relations were expected. To validate this assumption, an alternative model freely estimating these paths was tested (Path Model 3.1, see Appendix A.6.). No significant paths between storage and retrieval and TMM-TM were found. Furthermore, chi-square difference testing showed no significant improve in model fit for the alternative model ($\chi^2_{diff} = 4.40$, $df = 4$, $p > .05$).

Hypothesis 20 is also partially supported by the data. In Path Model 4, basic reflection was found to be significantly positively related to TMM-SC ($\beta = .50$, $p < .01$) and TMM-PC ($\beta = .69$, $p < .01$). However, no significant relation was found with respect to TMM-MC. Thus, Hypothesis 20 is supported with respect to TMM-SC and TMM-PC, but not supported with respect to TMM-MC. The path coefficient between basic reflection and TMM-OC was fixed to zero since no relation was expected. To validate this assumption, Path Model 4 was compared to an alternative model freely estimating this path (Path Model 4.1, see Appendix A.6.). No significant path between basic reflection and TMM-OC was found in the alternative model. Moreover, chi-square difference testing showed no significant improve in model fit for the alternative model ($\chi^2_{diff} = 0.61$, $df = 1$, $p > .05$).

Partial support is also given with respect to Hypothesis 21. In support for the hypothesis, significant positive relations between team process reflection and TMM-SC ($\beta = .54$, $p < .01$), TMM-MC ($\beta = .35$, $p < .05$), and TMM-PC ($\beta = .52$, $p < .01$) were found in Path Model 5. However, no significant relation between team process reflection and TMM-OC was found. Thus, like Hypotheses 18 and 19, Hypothesis 21 is supported with respect to TMM-SC, TMM-MC, and TMM-PC, but not supported with respect to TMM-OC.

Hypotheses 22 to 25 state positive relations between TMM-TM variables and team performance variables. Hypotheses 22 and 23 were not supported since no significant relations were found between TMM-OC and team performance variables as well as between TMM-SC and team performance variables. The path coefficient between TMM-SC and team innovativeness was fixed to zero since no relation was expected. To validate this assumption, Path Model 2 was compared to an alternative model freely estimating this path (Path Model 2.1, see Appendix A.6.). No significant path between TMM-SC and team innovativeness was found in the alternative model. Moreover, chi-square difference testing showed no significant improve in model fit for the alternative model ($\chi^2_{diff} = 0.12$, $df = 1$, $p > .05$).

In contrast to Hypotheses 22 and 23, Hypothesis 24 was fully supported by the data. TMM-MC was significantly positively related to team effectiveness ($\beta = .32$, $p < .01$), team efficiency ($\beta = .37$, $p < .01$), and team innovativeness ($\beta = .30$, $p < .05$). Partial support was

found with respect to Hypothesis 25. TMM-PC was significantly positively related to team innovativeness ($\beta = .21$, $p < .05$), but not related to team effectiveness and efficiency. Hence, Hypothesis 25 is supported with respect to team innovativeness, but not supported with respect to team effectiveness and efficiency.

With respect to the investigated control variables, two constant results were found throughout Path Models 2-5. (1) Team size significantly positively predicted TMM-SC (Path Model 2: $\beta = .46$, $p < .01$; Path Model 3: $\beta = .38$, $p < .05$; Path Model 4: $\beta = .35$, $p < .05$; Path Model 5: $\beta = .31$, $p < .05$). (2) Teamwork time significantly positively predicted TMM-OC (Path Model 2: $\beta = .32$, $p < .01$; Path Model 3: $\beta = .33$, $p < .01$; Path Model 4: $\beta = .34$, $p < .01$; Path Model 5: $\beta = .42$, $p < .01$). Moreover, teamwork time was the only significant predictor of TMM-OC. Other results concerning control variables differed to some extent between the path models. A significant negative path between teamwork time and TMM-SC was found in Path Models 4 ($\beta = -.24$, $p < .05$) and 5 ($\beta = -.22$, $p < .05$). A significant positive path between team size and TMM-PC was found in Path Model 3 ($\beta = .29$, $p < .05$). Path Model 2 showed a significant positive relation between teamwork time and TMM-MC ($\beta = .19$, $p < .05$).

Table 17

*Descriptive Statistics, ICC(1) Values, and Between Teams Correlation Matrix (Research Questions 3 and 4)*

| Variable | *M* | *SD* | *ICC(1)* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Team size | 5.70 | 2.19 | .76 | | | | | | | | | | | | | |
| 2. Teamwork time | 24.16 | 13.52 | .50 | -.16 | | | | | | | | | | | | |
| 3. Knowledge sharing | 4.34 | .25 | .22 | -.48** | .06 | | | | | | | | | | | |
| 4. Task reflection | 4.24 | .31 | .24 | -.42** | .07 | .86** | | | | | | | | | | |
| 5. Basic reflection | 3.84 | .27 | .14 | -.30* | .37** | .26* | .41** | | | | | | | | | |
| 6. Team process reflection | 3.10 | .36 | .18 | -.30* | .36** | .66** | .67** | .65** | | | | | | | | |
| 7. Storage and retrieval | 3.97 | .49 | .38 | .03 | .46** | .12 | .10 | .40** | .39** | | | | | | | |
| 8. TMM-OC | .46 | .35 | -- | -.01 | .32* | -.18 | -.08 | .33** | -.03 | .27* | | | | | | |
| 9. TMM-SC | 1.17 | .50 | -- | .21 | -.08 | .26* | .18 | .18 | .30* | -.19 | -.11 | | | | | |
| 10. TMM-MC | .50 | .41 | -- | .00 | .16 | .39** | .25* | .24 | .43** | .24 | .07 | .14 | | | | |
| 11. TMM-PC | .54 | .35 | -- | .06 | .04 | .24 | .36** | .40** | .35** | .13 | -.22 | .31* | .07 | | | |
| 12. Effectiveness[1] | 4.32 | .48 | -- | -.01 | .03 | .44** | .25 | .20 | .33* | -.04 | -.09 | .22 | .32* | .10 | | |
| 13. Efficiency[1] | 3.78 | .59 | -- | -.06 | .01 | .43** | .17 | .19 | .32* | .04 | -.14 | .05 | .35** | .02 | .73** | |
| 14. Innovativeness[1] | 3.59 | .70 | -- | .19 | .17 | .05 | .14 | .12 | .39** | .16 | .07 | .11 | .34* | .20 | .49** | .30* |

*Note.* $N_3$ = 63 teams.

[1] $N_4$ = 54 teams.

* p > .05, ** p > .01, two-tailed.

Table 18

*Model Estimates of the Between Teams Path Models 2-5*

| | TMM-OC | TMM-SC | TMM-MC | TMM-PC | TMM-OC | TMM-SC | TMM-MC | TMM-PC |
|---|---|---|---|---|---|---|---|---|
| Predictors | Path Model 2 | | | | Path Model 3 | | | |
| Team size | -.09 | .46** | .24 | .29 | -.04 | .38* | .15 | .29* |
| Teamwork time | .32** | -.01 | .19* | .06 | .33** | -.06 | .19 | .05 |
| Knowledge sharing | -.26 | .51** | .42** | .45* | | | | |
| Task reflection | | | | | -.20 | .43** | .29* | .55** |
| | Path Model 4 | | | | Path Model 5 | | | |
| Team size | .03 | .35* | .10 | .27 | -.01 | .31* | .10 | .18 |
| Teamwork time | .34** | -.24* | .08 | -.23 | .42** | -.22* | .06 | -.14 |
| Basic reflection | -- | .50** | .23 | .69** | | | | |
| Team process reflection | | | | | -.25 | .54** | .35* | .52** |

| | Team performance, Path Models 2-5 | | |
|---|---|---|---|
| Predictors | Effectiveness | Efficiency | Innovativeness |
| TMM-OC | -.10 | -.18 | .07 |
| TMM-SC | .13 | -.04 | -- |
| TMM-MC | .32** | .37** | .30* |
| TMM-PC | -.01 | -.05 | .21* |

*Note*. Model estimates between predictors and TMM-TM variables are based on $N_3 = 63$ teams, model estimates between predictors and team performance variables are based on $N_4 = 54$ teams. Standardized path coefficients are reported. Model fit Path Model 2: $\chi 2 = 16.35$, df = 16, p = .43; CFI = 1.00; TLI = 0.99; SRMR (between) = 0.080; RMSEA = 0.009; Path Model 3: $\chi 2 = 17.00$, df = 23, p = .81; CFI = 1.00; TLI = 1.16; SRMR (between) = 0.062; RMSEA = 0.000; Path Model 4: $\chi 2 = 16.51$, df = 17, p = .49; CFI = 1.00; TLI = 1.02; SRMR (between) = 0.075; RMSEA = 0.000; Path Model 5: $\chi 2 = 10.00$, df = 16, p = .87; CFI = 1.00; TLI = 1.20; SRMR (between) = 0.060; RMSEA = 0.000.

* p > .05; ** p > .01, two-tailed.

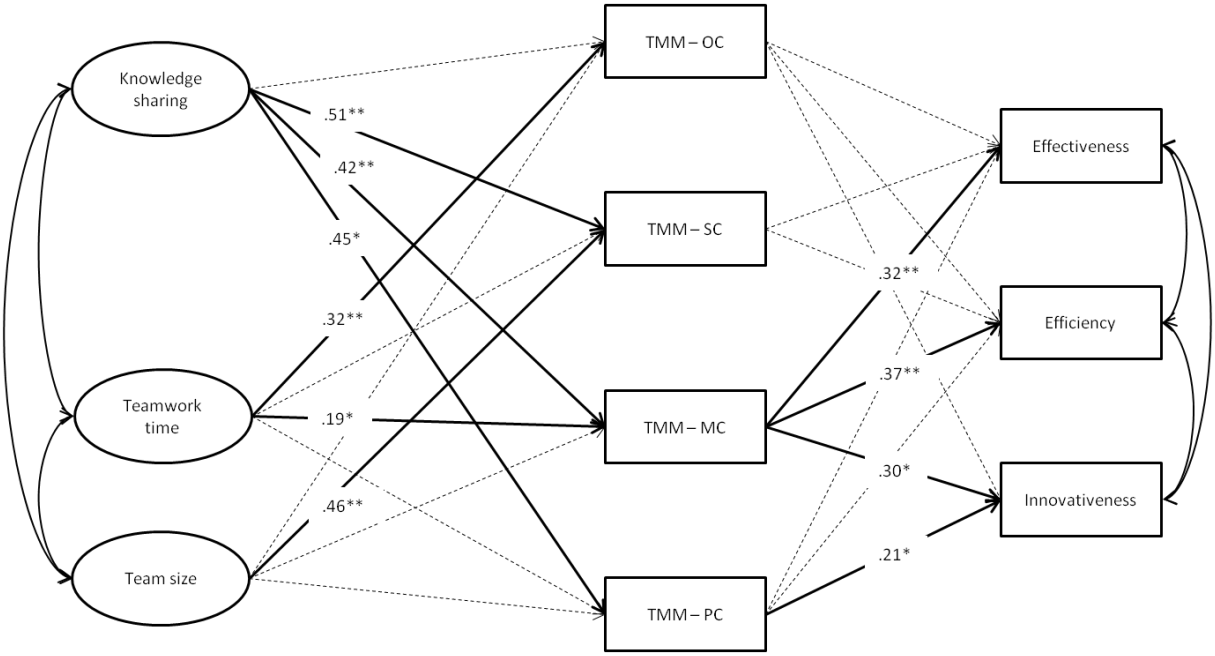


*Figure 10.* Path Model 2: Team-level path model of the relations between team performance variables, TMM-TM variables, knowledge sharing, and control variables. Normal arrow path, $p < .05$; dashed arrow path, $p$ = not significant ($p > .05$). Only significant standardized path coefficients are reported.

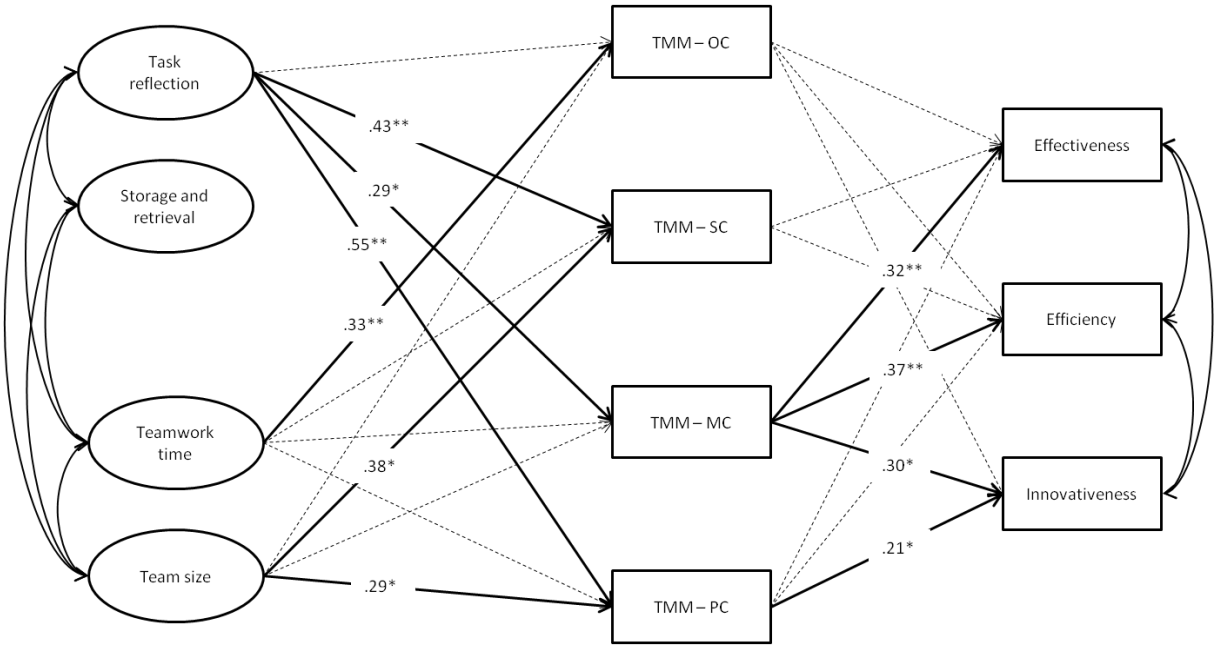


*Figure 11.* Path Model 3: Team-level path model of the relations between team performance variables, TMM-TM variables, task reflection, storage and retrieval, and control variables. Path coefficients between storage and retrieval and TMM-TM variables are fixed to zero. Normal arrow path, $p < .05$; dashed arrow path, $p$ = not significant ($p > .05$). Only significant standardized path coefficients are reported.

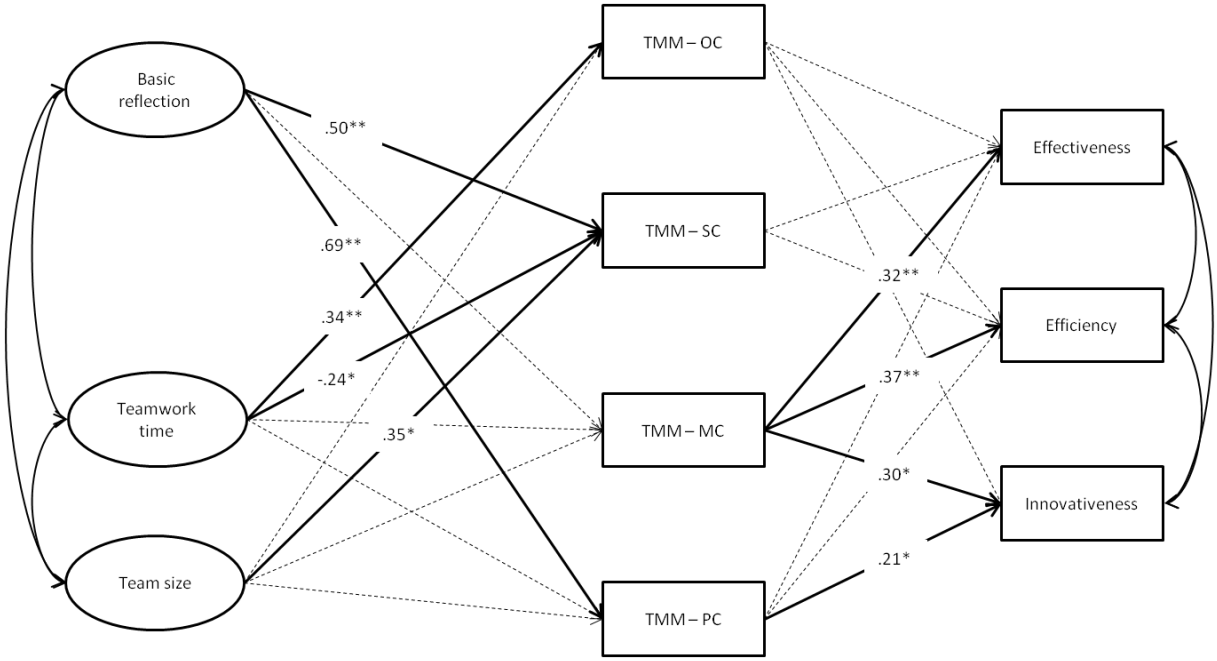


*Figure 12.* Path Model 4: Team-level path model of the relations between team performance variables, TMM-TM variables, basic reflection, and control variables. Normal arrow path, $p < .05$; dashed arrow path, $p$ = not significant ($p > .05$). Only significant standardized path coefficients are reported.

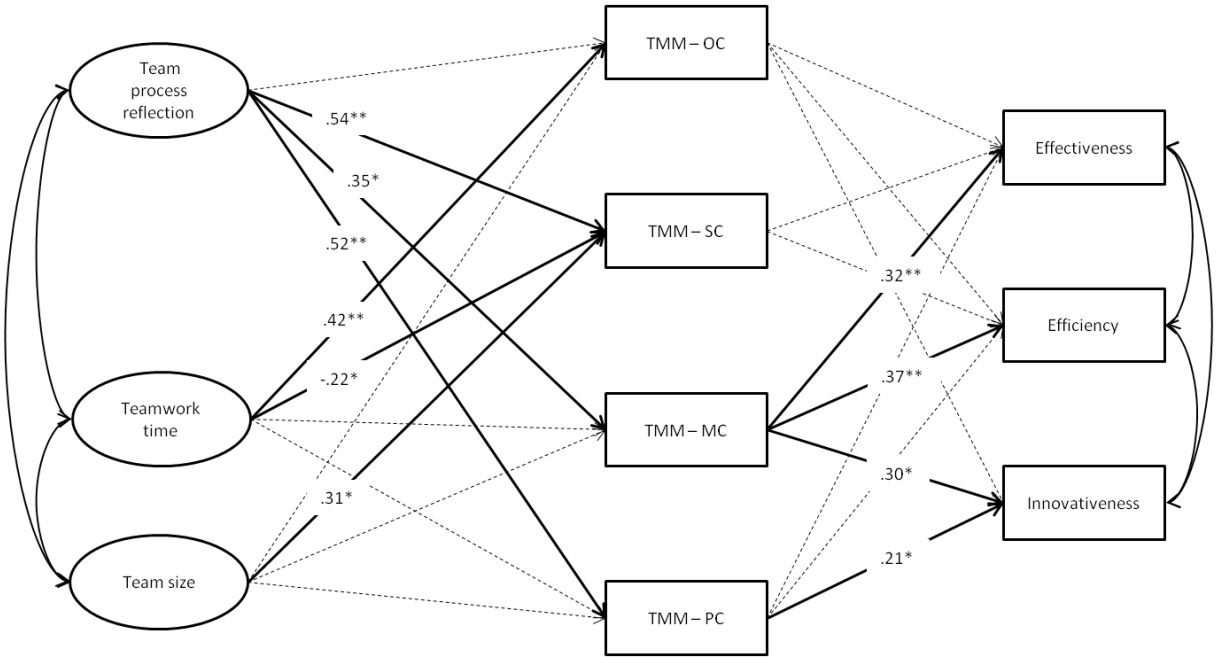


*Figure 13.* Path Model 5: Team-level path model of the relations between team performance variables, TMM-TM variables, team process reflection, and control variables. Normal arrow path, $p < .05$; dashed arrow path, $p$ = not significant ($p > .05$). Only significant standardized path coefficients are reported.

### 4.5.3. Additional analyses – Testing for mediation

In addition to testing the formulated hypotheses, it was analyzed whether TMM-TM mediates between team learning activities and team performance. Indirect effects testing for mediation were estimated if, (1) a significant path was found between a team learning activity and a TMM-TM variable and (2) the TMM-TM variable significantly predicted a team performance variable (see Hayes, 2013). With respect to Path Model 2, support for a mediation effect of TMM-MC between knowledge sharing and effectiveness ($\beta = .14$, $p < .05$) as well as between knowledge sharing and efficiency ($\beta = .16$, $p < .05$) was found. Specific indirect effects between knowledge sharing and innovativeness through TMM-MC ($\beta = .13$, $p = .06$) and TMM-PC ($\beta = .09$, $p = .09$) were not significant. However, the sum of these indirect effects was significant ($\beta = .22$, $p < .01$), indicating that, taken together, TMM-MC and TMM-PC mediate between knowledge sharing and innovativeness.

Testing indirect effects with respect to Path Model 3, it was found that TMM-MC mediates between task reflection and efficiency ($\beta = .11$, $p < .05$) and that TMM-PC mediates between task reflection and innovativeness ($\beta = .12$, $p < .05$). The indirect effects of task reflection through TMM-MC on effectiveness ($\beta = .09$, $p = .07$) and innovativeness ($\beta = .09$, $p = .14$) were not significant. However, the sum of indirect effects of task reflection on innovativeness through TMM-MC and TMM-PC was significant ($\beta = .20$, $p < .05$), indicating that, taken together, TMM-MC and TMM-PC mediate between task reflection and innovativeness.

In Path Model 4, a significant indirect effect of basic reflection through TMM-PC on team innovativeness was found ($\beta = .15$, $p < .05$), indicating that TMM-PC mediates between basic reflection and team innovativeness.

With respect to Path Model 5, support for a mediation effect of TMM-MC between team process reflection and efficiency was found ($\beta = .13$, $p < .05$). The indirect effect of team process reflection through TMM-MC on effectiveness was not significant ($\beta = .11$, $p = .06$). Specific indirect effects between team process reflection and innovativeness through TMM-MC ($\beta = .10$, $p = .16$) and TMM-PC ($\beta = .11$, $p = .10$) were also not significant. However, the sum of these indirect effects was significant ($\beta = .21$, $p < .05$), indicating that, taken together, TMM-MC and TMM-PC mediate between team process reflection and team innovativeness.

## 4.6. Result overview for the tested hypotheses

The results of hypothesis testing with respect to Research Questions 1-4 are summed up in Table 19.

Table 19

*Results for the Tested Hypotheses*

| Research Question/Hypothesis | Independent Variable | Dependent Variable | Mediator | Moderator | Direction | Results[1] |
|---|---|---|---|---|---|---|
| **Research Question 1** | | | | | | |
| Hypothesis 1 | Safe team climate | Knowledge sharing | -- | -- | Positive direct | Confirmed |
| Hypothesis 2 | Safe team climate | Task reflection | -- | -- | Positive direct | Confirmed |
| Hypothesis 3 | Safe team climate | Basic reflection | -- | -- | Positive direct | Rejected |
| Hypothesis 4 | Safe team climate | Team process reflection | -- | -- | Positive direct | Confirmed |
| Hypothesis 5 | Task interdependence | Knowledge sharing | -- | -- | Positive direct | Confirmed |
| Hypothesis 6 | Task interdependence | Task reflection | -- | -- | Positive direct | Confirmed |
| Hypothesis 7 | Task interdependence | Basic reflection | -- | -- | Positive direct | Confirmed |
| Hypothesis 8 | Task interdependence | Team process reflection | -- | -- | Positive direct | Confirmed |

*(Table continues)*

*(Table continued)*

| Research Question/Hypothesis | Independent Variable | Dependent Variable | Mediator | Moderator | Direction | Results |
|---|---|---|---|---|---|---|
| Hypothesis 9 | Task interdependence | Storage and retrieval | -- | -- | Positive direct | Confirmed |
| Hypothesis 10 | Team expert roles | Knowledge sharing | -- | -- | Negative direct | Confirmed |
| Hypothesis 11 | Team expert roles | Task reflection | -- | -- | Negative direct | Confirmed |
| Hypothesis 12 | Team expert roles | Basic reflection | -- | -- | Positive direct | Rejected |
| Hypothesis 13 | Team expert roles | Team process reflection | -- | -- | Negative direct | Confirmed |
| Hypothesis 14 | Team expert roles | Storage and retrieval | -- | -- | Negative direct | Rejected |
| **Research Question 2** | | | | | | |
| Hypothesis 15 | Transformational leadership | Innovativeness | Team reflection | -- | Positive indirect | Partially supported: Team innovativeness-TMR |
| Hypothesis 16 | Transformational leadership | Innovativeness | Team reflection | Transformational leadership | Positive conditional indirect | Partially supported: Team innovativeness-TMR |
| Hypothesis 17 | Transformational leadership | Innovativeness | Team reflection | Safe team climate | Positive conditional indirect | Rejected |

*(Table continues)*

*(Table continued)*

| Research Question/Hypothesis | Independent Variable | Dependent Variable(s) | Mediator | Moderator | Direction | Results |
|---|---|---|---|---|---|---|
| **Research Question 3** | | | | | | |
| Hypothesis 18 | Knowledge sharing | TMM-OC, TMM-SC, TMM-MC, TMM-PC | -- | -- | Positive direct | Partially supported: TMM-SC, TMM-MC, TMM-PC |
| Hypothesis 19 | Task reflection | TMM-OC, TMM-SC, TMM-MC, TMM-PC | -- | -- | Positive direct | Partially supported: TMM-SC, TMM-MC, TMM-PC |
| Hypothesis 20 | Basic reflection | TMM-SC, TMM-MC, TMM-PC | -- | -- | Positive direct | Partially supported: TMM-SC, TMM-PC |
| Hypothesis 21 | Team process reflection | TMM-OC, TMM-SC, TMM-MC, TMM-PC | -- | -- | Positive direct | Partially supported: TMM-SC, TMM-MC, TMM-PC |
| **Research Question 4** | | | -- | -- | | |
| Hypothesis 22 | TMM-OC | Effectiveness, Efficiency, Innovativeness | -- | -- | Positive direct | Rejected |
| Hypothesis 23 | TMM-SC | Effectiveness, Efficiency | -- | -- | Positive direct | Rejected |

*(Table continues)*

*(Table continued)*

| Research Question/Hypothesis | Independent Variable | Dependent Variable(s) | Mediator | Moderator | Direction | Results |
|---|---|---|---|---|---|---|
| Hypothesis 24 | TMM-MC | Effectiveness, Efficiency, Innovativeness | -- | -- | Positive direct | Confirmed |
| Hypothesis 25 | TMM-PC | Effectiveness, Efficiency, Innovativeness | -- | -- | Positive direct | Partially supported: Innovativeness |

[1]Given partially supported hypotheses, dependent variables are indicated for which results were in accordance with the respective hypothesis.

# 5. Discussion

The discussion of the study results is structured by the posed research questions and the applied analyses. Firstly, results with respect to Research Question 1 will be discussed (5.1.). Secondly, results concerning Research Question 2 are in focus of the discussion (5.2.). Thirdly, results with respect to Research Questions 3 and 4 are discussed together in one chapter (5.3.), since the results concerning these research questions are drawn from the same empirical models.

## 5.1. Research Question 1: Team learning processes and the interpersonal context

### 5.1.1. Interpretation of study results

To answer Research Question 1 (What beliefs about the team's interpersonal context are related to which team learning activity?), a study with organizational complex decision-making teams was carried out. Aim of the study was to contribute to the literature on team learning by investigating the relations between interpersonal context beliefs and team learning activities in greater detail than has been done before. A path model (Path Model 1) comprising distinct relations between three different interpersonal context beliefs and five different team learning activities was tested.

Shared beliefs about the team's interpersonal context were investigated with respect to safe team climate, task interdependence and team expert roles. In Hypotheses 1-4, it is proposed that safe team climate is a positive predictor of knowledge sharing, task reflection, basic reflection, and team process reflection. Safe team climate positively predicted knowledge sharing, task reflection, and team process reflection, but not basic reflection. It is concluded that, although a safe team climate might foster the team learning activities of knowledge sharing, task reflection, and team process reflection by alleviating team members' fears of rejection or punishment by their social context, it is not sufficient to support team reflection on basic assumptions, like e.g. reflection of team goals or work methods. An explanation for this result may be that basic reflection requires something beyond a safe team climate. In the context of everyday teamwork, team members may primarily focus on task execution and the solving of task related problems. Whereas the relevance of task reflection and team process reflection might be more apparent for this everyday teamwork, reflecting on basic assumption might appear somewhat counterproductive, as this kind of reflection is not directly focused on task related problems, but rather deals with fundamental issues, e.g. the pursued goals of the team. According to Sessa and London (2008b), a team has to develop

maturity to perform such seemingly counterproductive team reflection activities. They argue that only mature teams have the readiness to perform transformative learning, a type of team learning that "occurs when the group needs to make a major shift in its structure, task, or goals" (p. 555). Although a safe team climate might be supportive in developing maturity, Sessa and London (2008b) suggest that more is needed for a team to mature into a complex and integrated system (e.g. team identification, cohesiveness, and team potency). It is concluded that a safe team climate by itself may not be sufficient to widen the team's focus of reflection beyond task reflection and team process reflection to also incorporate reflection on basic assumptions, as only teams that have developed maturity may successfully apply basic reflection.

As expected, no relation was found between safe team climate and storage and retrieval. This is explained by the specific form of storage and retrieval investigated. It is suggested that storage and retrieval by use of material repositories does not depend on the alleviation of social fears by a safe team climate as it is not performed in social interactions. Overall, results demonstrate that relations between a safe team climate and team learning activities are not as straightforward as suggested in the existent literature. Whereas current theoretical models (e.g. Knapp, 2010; Van den Bossche et al., 2006) and empirical studies (e.g. Boon et al., 2013; Edmondson, 1999; Van den Bossche et al., 2006) propose a positive relation between a safe team climate and overarching unidimensional constructs of team learning, this study shows that a safe team climate is differentially related to distinct team learning activities. Thus, whether a safe team climate supports a team learning activity depends on the kind of team learning activity under investigation. Findings indicate that knowledge sharing, task reflection, and team process reflection are supported by a safe team climate, whereas basic reflection and storage and retrieval are not. These results suggest that theories and models on team learning and interpersonal context beliefs need to become more fine grained by incorporating distinct relations between a safe team climate and different kinds of team learning activities.

Hypotheses 5 to 9 state positive relations between task interdependence and all team learning activities investigated. These hypotheses were fully supported by the data. Hence, task interdependence is proposed to be a key characteristic of the team's interpersonal context. Concerning the investigated interpersonal context variables, task interdependence is the only significant predictor of basic reflection and storage and retrieval. It may foster basic reflection since it is a fundamental precondition for the team to develop maturity. To mature into a complex and integrated system, team members' tasks need to be intertwined (Sessa &

London, 2008b). Thus, only teams with a high amount of task interdependence may develop the maturity to engage in transformational learning, which encompasses basic reflection (Sessa & London, 2008b). Moreover, it is proposed that task interdependence is necessary for the team to even have commonly shared task-related basic assumptions (see 3.1.2). Consequently, defining the common ground on which to reflect on, task interdependence is suggested to be a prerequisite of basic reflection. With respect to storage and retrieval, it is proposed that task interdependence fosters storage and retrieval, since storage and retrieval may be helpful for team members to be on the same page with respect to their intertwined work activities (see 3.1.2.). Overall, study results concur with previous findings supporting a positive link between task interdependence and team learning activities (Edmondson, 2002; Van den Bossche et al., 2006; Van Woerkom, 2011) and are in line with theoretical models on team learning and interpersonal context beliefs (Knapp, 2010; Van den Bossche et al., 2006). Nevertheless, this study goes beyond past research by demonstrating positive relations with respect to the distinct team learning activities of knowledge sharing, task reflection, basic reflection, team process reflection, and storage and retrieval.

In Hypotheses 10, 11, 13, and 14, team expert roles are expected to negatively predict the team learning activities of knowledge sharing, task reflection, team process reflection, and storage and retrieval. Significant negative relations were found between team expert roles and knowledge sharing, task reflection, as well as team process reflection (Hypotheses 10, 11, 13). These results concur with studies on expertise diversity demonstrating a negative relation between distinct team expert roles and team learning (Bunderson & Sutcliffe, 2002; Van der Vegt & Bunderson, 2005; see 3.1.3.). Different than expected, storage and retrieval was not negatively predicted by team expert roles. This result might have been caused by diverging effects of team expert roles on storage and retrieval. On the one hand, it is plausible that strong team expert roles exacerbate the identification of knowledge relevant for storage and retrieval and raise communication problems impeding the development of a common language necessary for successful storage and retrieval (see 3.1.3.). On the other hand, strong expert roles may also trigger storage and retrieval. If different experts are motivated to settle on a common language and to learn about each other's specialization and capabilities, team members might utilize the codification of knowledge in common team documents to support this process (Oertel & Antoni, 2015). Thus, in future research it may be interesting to focus on moderating variables, such as, for example, a team's learning orientation, to identify the circumstances that support storage and retrieval in case of strong team expert roles.

Hypothesis 12, stating a positive relation between team expert roles and basic reflection, was not supported by the data either. An explanation for this result may be that strong team expert roles cause communication problems, stereotyping, and in-group/out-group biases that exacerbate team learning activities (Bunderson & Sutcliffe, 2002). As a consequence, potential positive effects of diverse expertise on the reflection of basic assumptions may be undermined. Whether team expert roles unfold a positive impact on basic reflection probably depends on moderating variables. Van der Vegt & Bunderson (2005) identified collective team identification as a moderator in the relation between expertise diversity and team learning. They conclude that, if team members identify with the team, expertise diversity can positively affect performance outcomes by stimulating search and learning behaviors within the team. Likewise, future research should put a focus on moderating variables in the relations between team expert roles and team reflection activities. This would help to underline the notion that more is necessary for fruitful intellectual interaction than staffing a team with different kinds of experts.

Overall, it is concluded that not only objective identifiable team expert roles (e.g. expertise diversity), but also the subjective perception of team expert roles, as manifested in shared beliefs about the team's interpersonal context, is relevant for team learning activities. This conclusion is in line with expectancy theory, which stresses the importance of how team expert roles are perceived by the subject (Vroom, 1964; Bunderson & Sutcliffe, 2002). However, the impact of how team members subjectively perceive the manifestation of team expert roles in the team on team learning has been neglected in theorizing and research on the antecedents of team learning activities. Therefore, it is proposed that future theorizing and research may further elaborate on the subjective notion of team expert roles as an antecedent of team learning activities.

Team tenure and team size were investigated as control variables. In accordance with the expectation that team size negatively affects those team learning activities performed in direct interaction, support was found that knowledge sharing and basic reflection decrease with increasing team size. However, team size was not significantly related to task reflection and team process reflection. The respective path coefficients were pointing in the expected direction, but were not significant. Team size might be less important for these team learning activities because task related problems and team interaction processes may be discussed only among those team members who are familiar with the problem or involved in the relevant team interaction processes. Thus, the activities of task reflection and team process reflection may be less affected by team size since only part of the team may be involved. In contrast,

there may be a stronger need to approach a bigger proportion of the team when overarching goals and basic assumptions are discussed and when important information is shared. Consequently, knowledge sharing and basic reflection may more likely be negatively affected by team size.

Concerning team tenure, no support for the assumed positive relations with respect to basic reflection and team process reflection was found. Team tenure was used as a rough estimate of team maturity. However, although it is plausible that a certain amount of time working together is necessary for the team to develop the maturity to perform basic reflection and team process reflection, simply spending time of working together might not necessarily yield this outcome. Accordingly, results by Raes et al. (2015) suggest that a team has to develop psychological safety and team potency in order to mature. Therefore, future research should rather apply a direct measure of team maturity (cf. Raes et al., 2015). In addition, with increasing tenure a team might not only develop maturity, but also establish work routines, decreasing the amount of team reflection (West, 1996; Wilson et al., 2007). Accordingly, future research on team reflection and team maturity should take the effect of establishing work routines into account.

Overall, study results have important implications concerning the antecedents of collective learning activities in organizational teams. Theories on dialogic development in authentic work contexts particularly emphasize the importance of antecedents that are located within the social context of the team (Garavan et al., 2015). In line with these theories, study results show that beliefs about the teams' interpersonal context are important antecedents of team learning activities. Moreover, study results go beyond current studies and theoretical models of team learning activities and interpersonal context beliefs by applying a multidimensional approach investigating distinct relations between different team learning activities and different interpersonal context beliefs. Study results may stimulate the formulation of more fine grained theoretical models on team learning that incorporate distinct relations between different team learning activities and different interpersonal context beliefs.

The conducted study was aiming at a more detailed understanding of the relations between interpersonal context beliefs and different team learning activities. It turned out that all three investigated interpersonal context beliefs were important with respect to certain team learning activities under investigation, but only task interdependence was a significant positive predictor of all. Therefore, task interdependence is highlighted as a key component of team members' shared interpersonal context beliefs.

### 5.1.2. Study limitations and future research directions

Four limitations of the study that are specific to the investigation of Research Question 1 are pointed out. Subsequent directions for future research are derived (1) Besides the three interpersonal context beliefs investigated, there are probably other interpersonal context beliefs that affect team learning activities as well. For example, studies by Van den Bossche et al. (2006) and Boon et al. (2013) suggest team potency and task cohesion to be interpersonal context beliefs that are crucial for team learning activities. Future research should further expand our knowledge about the complex relations between different interpersonal context beliefs and distinct team learning activities.

(2) It has been pointed out that it may depend on moderating variables, like e.g. collective team identification (Van der Vegt & Bunderson, 2005), whether team expert roles positively affect basic reflection (see 5.1.1.). However, in this study no moderating variables have been investigated in this respect. Hence, future research should focus on moderating variables in the relations between team expert roles and team reflection activities.

(3) The control variable of team tenure was taken as a rough estimate of team maturity. However, the validity of this measure with respect to team maturity may be doubted, since more is necessary for a team to develop team maturity than just spending time working together (see 5.1.1.). Therefore, in future research the relations between team maturity and team reflection activities should be investigated by applying a direct measure of team maturity.

(4) As data on dependent and independent variables were collected from team members applying similar methods (Likert-type scales), study results may be limited due to common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Harman's one-factor test was applied to assess whether a substantial amount of common method variance is present in the data (Podsakoff et al., 2003). The test yielded nine factors with an Eigenvalue greater than one. The first factor was accounting for 27 per cent of the covariance among measures. These results suggest that common method variance is not a serious concern regarding the investigation of Research Question 1. Nevertheless, in order to completely rule out common method variance, future research should apply various methods to measure team learning activities and antecedents.

Though Harman's one-factor test is one of the most widely used methods to address common method variance (Boerner et al., 2007), it is acknowledged that a better solution to deal with the potential problem of common method variance would have been to apply multilevel structural equation modeling (SEM) integrating a measurement model at both the

individual and the team-level. This approach would have allowed to control for the effects of an unmeasured latent methods factor (Podsakoff et al., 2003; Richardson, Simmering, & Sturman, 2009). However, given the relatively high number of variables (and associated questionnaire items) in Path Model 1, testing the formulated hypotheses by applying multilevel SEM would have required a bigger sample than was available in this study (cf. Maas & Hox, 2005; Scherbaum & Ferreter, 2009). In future research, this problem may be solved by collecting data from a greater number of teams.

### 5.1.3. Practical implications

Results found in the investigation of Research Question 1 have important practical implications that are relevant for team members, team leaders, and team managers who want to support team learning activities. Findings indicate that task interdependence may facilitate team learning activities in complex decision-making teams. Accordingly, the work structures of teams' may be designed in ways that make team members experience the bonds between their individual contributions towards reaching a common goal. For this purpose, a distinct common task may be assigned to the team for which team managers may assign shared responsibility to the team as a whole. In addition, team leaders may emphasize team members' mutual interdependence in reaching the common goal. By generating awareness that everyone has got to do a good job for the team to succeed, team leaders may foster team members' motivation to apply team learning activities.

Team learning activities in complex decision-making teams, in particular knowledge sharing, task reflection, and team process reflection, might also be fostered by establishing a safe team climate. This can be achieved through practicing a positive and appreciative handling of errors and dissent opinions in the team. The team leader may play a key role in establishing a safe team climate. "If the leader is supportive, coaching-oriented, and has non-defensive responses to questions and challenges, members are likely to conclude that the team constitutes a safe environment" (Edmondson, 1999, p. 356).

In addition, knowledge sharing, task reflection, and team process reflection may also be supported by avoiding team members' perception of strong team expert roles to be present in the team. For this purpose, team leaders may create role partners for areas of expertise (Ellis et al, 2003). Furthermore, if the situation is given that team members are highly specialized in different fields, the perception of strong team expert roles may be diminished by emphasizing what team members have in common. For this purpose, the team leader may emphasize the team's common task as well as the non-specialist competencies that team

members have in common, e.g. social or meta competencies. This may cause team members to envision their team as a unit with everyone pulling together.

Finally, when putting teams together, team managers should keep in mind that knowledge sharing and basic reflection might be hampered when the team is large. To realize these practical implications, engagement of persons at different organizational levels (team manager, team leader, team member) is necessary.

## 5.2. Research Question 2: Team reflection linking transformational leadership and team innovativeness

### 5.2.1. Interpretation of study results

To answer Research Question 2, the mediating role of team reflection in the relation between transformational leadership and team innovativeness was investigated. Aim of the study was to contribute to the literature on transformational leadership, team innovativeness, and team learning activities by testing whether team reflection mediates between transformational leadership and team innovativeness and whether this mediation is moderated by transformational leadership and safe team climate. Team supervisors' and team members' perceptions of team innovativeness were investigated.

Study results partly supported the hypothesized mediation (Hypothesis 15). Support was found with respect to team member ratings of team innovativeness (team innovativeness-TMR). Thus, it may be derived that transformational leadership positively affects team innovativeness-TMR by triggering team reflection activities which in turn support team member ratings of team innovativeness. This result is in line with prevalent theories on transformational leadership (e.g. Bass & Riggio, 2006) and team reflection (e.g. West, 1996, 2000), as well as with current studies demonstrating a positive relation between transformational leadership and team reflection (Bucic et al., 2010; Raes et al., 2013; Schippers et al., 2008) and between team reflection and team innovativeness (Dayan & Basarir, 2010; Schippers et al. 2015; Tjosvold et al., 2004; Van Woerkom & Croon, 2009) (see 2.3.2.2., 3.2.1). The present study contributes to this literature by directly testing for the mediation of team reflection in the relation between transformational leadership and team innovativeness. However, the hypothesized mediation was not supported with respect to team supervisor ratings of team innovativeness (team innovativeness-TSR).

Likewise, partial support was found for the hypothesis that transformational leadership moderates the mediating effect of team reflection (Hypothesis 16). Again, support was found with respect to team member ratings of team innovativeness, but not with respect

to team supervisor ratings. Results show that at least a moderate amount of transformational leadership (relative to the sample) is necessary for the positive link between team reflection and team innovativeness-TMR to emerge. Accordingly, the mediation effect was only significant in case of at least a moderate amount of transformational leadership. Thus, transformational leadership may not only support team innovativeness-TMR through stimulating activities of team reflection, but also by supporting team reflection to yield team innovativeness-TMR. Building on leadership theory (Bass & Riggio, 2006), it has been argued that empowerment of followers and charismatic role modeling behavior, as incorporated in transformational leadership style, foster the process of putting innovative ideas resulting from team reflection into practice (see 3.2.2.1.).

No support was found for the hypothesis that safe team climate moderates the mediation of team reflection between transformational leadership and team innovativeness (Hypothesis 17). The Hypothesis was rejected with respect to team member ratings and team supervisor ratings of team innovativeness. Concerning team innovativeness-TMR, results show that the moderating effect of safe team climate between team reflection and team innovativeness is in the hypothesized direction, but not significant. Likewise, the conditional indirect effect, as indicated by the *IMM* and conditional indirect effects at different values of the moderator, is in the expected direction, but not significant. This pattern of results might be interpreted as an indicator that the hypothesized moderation of safe team climate may exist, but be not distinct enough to reach significance given the relatively small sample size of $N_2$ = 37 teams. In future research, retesting the hypothesis with a bigger sample may yield significant results. However, rejection of the hypothesis is reinforced by results found with respect to team innovativeness-TSR. Neither conditional nor conditional indirect effects for different values of the moderator were significant with respect to the dependent variable of team innovativeness-TSR, indicating that there is no moderating effect of safe team climate in the mediation of team reflection between transformational leadership and team innovativeness-TSR.

Diverging effects were found with respect to team member and team supervisor ratings of team innovativeness. Two reasons may account for this divergence. Firstly, team members and team supervisors might differ in their interests as well as with respect to the information they hold concerning team performance (Van Woerkom & Croon, 2009). Thus, they might have different perspectives on team innovativeness. Whereas team members may have more detailed insight into the innovativeness that happens in the course of daily team interaction, team supervisors' perspectives might be more distal and output oriented

(Edmondson, 1999), judging team innovativeness rather with respect to the achievement of concrete work goals. As a consequence, applying team member and team supervisor ratings of team innovativeness, two different constructs might be measured. It is proposed that team member ratings of team innovativeness mirror team members' perceptions of the team innovativeness that happens in the course of daily team interaction. In contrast, team supervisor ratings of team innovativeness may rather depend on the degree to which team innovativeness becomes visible to the supervisor with respect to a better achievement of work goals. Hence, team member ratings of team innovativeness may capture team members' overall engagement in activities comprising team innovativeness, whereas team supervisor ratings may be more focused on the teams' ability to successfully bring about goal-oriented team innovativeness. In support for this explanation, differences between the performance ratings of team members and supervisors are demonstrated in other empirical studies as well (e.g. Ancona, 1990; Ancona & Caldwell, 1992, Gladstein, 1984; Griffin et al., 2007; Van Woerkom & Croon, 2009).

Secondly, results might be divergent due to common method variance. Hülsheger et al. (2009) demonstrated that team process variables, assessed through team member ratings, are higher correlated with team member ratings of innovativeness than with independent ratings or objective criteria of innovation. They argue that:

> If the same individuals report on team processes as well as on their team's or their own innovative performance, correlations are likely to be higher, because not only is the same measurement method used (questionnaires) but also the same information source (team members). (Hülsheger et al., 2009, p. 1133)

Accordingly, team innovativeness-TMR was found to be higher correlated with the team process variables of safe team climate and team reflection than team innovativeness-TSR (see Table 13). Applying common methods, the covariance between dependent and independent variables might be overestimated due to, for example, respondents' tendency to keep their responses consistent or implicit theories of respondents about relationships (Podsakoff et al., 2003). As a consequence, results found with respect to team innovativeness-TMR might be biased due to the applied measurement method. To assess whether a substantial amount of common method variance is present in the data, Harman's one-factor test was conducted (Podsakoff et al., 2003). The test yielded five factors with an Eigenvalue greater than one. The first factor was accounting for 29 per cent of the covariance among measures. This suggests that common method variance is not a serious concern in this study. Consequently, pondering

the two given explanations, the first reason is interpreted to have more explanatory weight with respect to the found pattern of results.

Thus, the mediating role of team reflection in the relation between transformational leadership and team innovativeness may be distinct only with respect to team innovativeness as perceived by team members, but not with respect to team innovativeness as perceived by team supervisors. This pattern of results might be due to a stronger effect of team reflection on team innovativeness-TMR than on team innovativeness-TSR, which is mirrored by the correlations found in this study (see Table 13). Team reflection is assumed to affect team innovativeness-TMR since innovative ideas for team innovativeness are generated, discussed, and evaluated through team reflection in the course of daily team interaction (West, 1996, 2000). Thus, team reflection is an important driver of the team innovativeness that happens inside the team in the course of daily work. Further, it is assumed that team members fully perceive the team innovativeness of their own team. Thus, team reflection is proposed to be directly linked to team innovativeness as perceived by team members. In contrast, the team's supervisor might only perceive a certain proportion of the overall team innovativeness. In particular, it is proposed that the team's supervisor mostly perceives only those aspects of team innovativeness that lead to a better achievement of work goals. However, whether team innovativeness yields improved work performance probably depends also on other factors apart from team reflection. Study results by Eisenbeiss et al. (2008) propose that support for innovation given by the team leader as well as shared group norms for excellence (climate for excellence) are crucial with respect to supervisor ratings of team innovativeness. Schippers et al. (2008) highlight the mediation role of shared vision between transformational leadership and team performance as rated by team supervisors in addition to team reflection. Nijstad et al. (2014) propose the variable of participative safety to play a mediating role between transformational leadership and team supervisor ratings of team innovativeness. Thus, team reflection might affect team supervisor ratings of team innovativeness less than it affects overall team innovativeness, since other factors than team reflection are probably also crucial for team innovativeness to yield a better achievement of work goals. However, empirical studies have only begun to unravel the complex mechanisms that link transformational leadership and team innovativeness. Further research is necessary to reinforce a stable pattern of results.

Concerning the organizational type, results show that in profit organizations team innovativeness is rated higher by team members than in non-profit organizations. This may be because team innovativeness is more effectively promoted in profit organizations, as leaders

put a stronger focus on flexibility and competitiveness (Ruvio et al., 2010; see 3.2.3.). However, no significant effect of the organizational type was found for team supervisor ratings of team innovativeness. Common method variance can be excluded as an explanation of these diverging results as the organizational type is an objective characteristic of the organization and not subjectively rated by team members. Drawing upon the explanation that innovativeness-TMR and team innovativeness-TSR are different constructs, it is proposed that the environment of a profit organization may encourage team innovativeness in daily team interaction, which is perceived by team members, but fails to lift this team innovativeness to a level where it may support goal achievement, which is perceived by team supervisors. Hence, a stronger focus on flexibility and competitiveness in profit organizations might only support team members' engagement in activities comprising team innovativeness, but not their competence to successfully bring about goal-oriented team innovativeness.

No effect of team size on team innovativeness was found with respect to team member and team supervisor ratings. A possible explanation for this result is that team innovativeness in larger teams may not only benefit from more resources (Hülsheger et al., 2009), but may also suffer from more relationship conflicts and difficulties in coordinating efforts, since there are more different opinions and personalities that may collide. These negative side effects of team interaction may undermine the positive effect of having more resources (Jehn, Northcraft, & Neale, 1999).

In sum, the present study expands current knowledge about the relation between transformational leadership and team innovativeness by investigating the mediating role of team reflection and the moderating roles of transformational leadership and safe team climate in this mediation. Evidence is found that the effect of transformational leadership on team innovativeness-TMR is mediated by team reflection and that this mediation is moderated by transformational leadership. However, these relations were not supported with respect to team innovativeness-TSR. Concerning the moderating role of safe team climate, results found with respect to team innovativeness-TMR point in the direction of the formulated hypotheses, but nevertheless, were not significant. No support for moderation by safe team climate was found with respect to team innovativeness-TSR. It is suggested that the diverging results with respect to team member and team supervisor ratings of team innovativeness are due to team members' and team supervisors' different perspectives on team innovativeness.

### 5.2.2. Study limitations and future research directions

Four limitations of the study that are specific to the investigation of Research Question 2 are pointed out and subsequent directions for future research are derived. (1) Concerning the moderating effect of transformational leadership in the hypothesized mediation, it was not directly investigated how transformational leadership affects the relation between team reflection and team innovativeness. It has been argued that transformational leaders foster this relation through empowering followers and charismatic role modeling behavior (see 3.2.2.1.). However, it is up to future research to directly test these assumptions.

(2) It has been proposed that study results differ with respect to team member and team supervisor ratings of team innovativeness because team members and team supervisors differ in their perspectives on team innovativeness. In particular, it has been proposed that team member ratings of team innovativeness may capture team members' overall engagement in activities comprising team innovativeness, whereas team supervisor ratings may be more focused on the teams' ability to successfully bring about goal-oriented team innovativeness fostering team performance. However, these assumptions are not tested in this study. Hence, future research should further clarify whether and in which particular respect the perspectives of team members and team supervisors are different regarding team innovativeness.

(3) All the data in the study was collected by applying Likert-type scales and, in case of team member ratings of team innovativeness, the same information source (team members) was used for the measurement of dependent and independent variables. Thus, study results may be affected by common method variance (Hülsheger et al. 2009). Harman's one-factor test has been applied to assess whether a substantial amount of common method variance is present in the data (see 5.2.1.). Though the test suggested that common method variance is not a serious concern in this study, future research should apply various methods measuring team innovativeness and its antecedents to avoid the suspect of common method variance. Another possibility to deal with the problem of common method variance would have been to control for the effects of an unmeasured latent methods factor applying factor analysis in the context of multilevel structural equation modeling (see 5.1.2.). However, given the relatively small team-level sample size available for the investigation of Research Question 2, testing the formulated hypotheses applying multilevel SEM would have required a bigger sample than was available (cf. Maas & Hox, 2005; Scherbaum & Ferreter, 2009). Future research may avoid this problem by questioning a greater number of teams.

(4) Study results may be limited due to the relatively small sample size at the team-level. Though effects have to be relatively strong to be significant in small samples, they tend

to be less stable and are more sensitive to extreme scores (Nijstad et al, 2014). To examine the stability of findings, models were tested with and without additional covariates (see 4.4.2.; cf. Nijstad et al., 2014). Speaking in favor of stability, no deviant results were found with respect to the formulated hypotheses (see Appendix A.5.). Nevertheless, further studies are necessary to reinforce the robustness of the findings.

### 5.2.3. Practical implications

Practical implications derived from the investigation of Research Question 2 are limited to team innovativeness as perceived by team members, as hypotheses were not supported for team innovativeness as rated by team supervisors. Consequently, in the following, team innovativeness refers to team members' perception of team innovativeness.

Study results suggest that transformational leaders may foster team innovativeness by triggering team reflection. This may be achieved through actively challenging followers to rethink task related problems, pursued goals, work methods, strategies, and interaction processes from a different perspective. Leaders may also develop a shared vision that emphasizes a critical and reflective attitude towards work issues and apply charismatic role modeling of this attitude to reinforce that vision. Results further suggest that transformational leaders may support team reflection to yield team innovativeness, whereby empowerment of followers and charismatic role modeling behavior are proposed to be essential. Team leaders may empower team members by delegating important tasks and responsibilities to them as well as by giving them the trust and authority to make decisions and handle tasks their way. Role modeling of extraordinary capabilities, persistence and determination may encourage followers to put innovative ideas into practice. Furthermore, a safe team climate may have the potential to foster team reflection to yield team innovativeness. To establish a safe team climate, team members and leaders should practice a positive and appreciative handling of errors and dissent opinions in the team. Thereby, the fear of failure associated with the innovation process may be alleviated. Overall, results suggest that team innovativeness is fostered most likely when transformational leadership, team reflection, and safe team climate coincide.

## 5.3. Research Questions 3 and 4: Team performance, TMM-TM, and team learning activities

### 5.3.1. Interpretation of study results

With respect to Research Questions 3 and 4, it was investigated how team learning activities are related to TMM-TM and how TMM-TM is related to team performance. In that regard, aim of the present study was to shed some light on the barely researched construct of TMM-TM with respect to the team learning activities that make it emerge and its relations to team performance. Four team-level path models (Path Models 2-5) were estimated to investigate how the team learning activities of knowledge sharing, task reflection, team process reflection, basic reflection, and storage and retrieval are related to TMM-TM. The found relations between TMM-TM and team performance measures were constant across the four models. Team supervisor ratings of team performance were applied.

With respect to Research Question 3 (How are team learning activities related to TMM-TM?), partial support was found for Hypothesis 18, stating a positive relation between knowledge sharing and TMM-TM. The hypothesis is supported with respect to TMM about social (TMM-SC), meta (TMM-MC), and personal (TMM-PC) competencies of team members, but not with respect to TMM about occupational competencies (TMM-OC). The found positive relations reinforce the argument presented by Ellis et al. (2008) and Wilson et al. (2007), stating that team members become aware of each other's competencies by giving information to and requesting information from other team members (see 3.3.1.). However, the kind of TMM-TM knowledge mainly focused in the literature on TMS, namely TMM about team members' occupational competencies, was not predicted by knowledge sharing. In accordance with this result, Akgün et al. (2005) found no relation between team member communication and TMS development. In contrast, Yuan et al. (2010) found a positive relation between the amount of knowledge sharing of individual team members and the amount of shared team-level knowledge about team members' occupational competencies. A possible explanation for these inconsistent results may be that different phases of team development impact the relations between team learning activities and shared team-level knowledge about team members' occupational competencies as incorporated in the teams TMS (Ren & Argote, 2011). Supporting this interpretation, Oertel and Antoni (2015) found that knowledge-based team learning activities (storage and retrieval) are more important for TMS development during early stages of team development, whereas the team learning activities of team reflection and co-construction are more important in later stages. However,

it is up to future research to test whether stages of team development also affect the relation between knowledge sharing and TMM-OC.

Partial support is also given for Hypothesis 19, stating a positive relation between task reflection and TMM-TM variables. Like Hypothesis 18, Hypothesis 19 is supported with respect to TMM about social, meta, and personal competencies of team members, but not with respect to TMM about occupational competencies. The significant positive relations found in the present study are in line with the arguments presented by Austin (2003) and Zajac et al. (2014), pointing out that it is through the discussion of task related problems that team members refine their initial understanding of each other's competencies and arrive at a more detailed, accurate, and commonly shared mental model of how competencies are distributed in the team (see 3.3.1.). However, again no support was found with respect to TMM-OC. This result seems to be in contrast with studies by Oertel and Antoni (2015) as well as Dayan and Basarir (2010), who found task related team reflection to be a positive predictor of TMS. But the inconsistency may be resolved by an important result of Oertel and Antoni (2015). They found that task reflection is more important for TMS development at later stages of team development than at early stages. Consequently, the relation between task reflection and TMM-OC may be moderated by stages of team development. Therefore, as for knowledge sharing, it may be interesting to investigate the impact of phases of team development on the relation between task reflection and TMM-OC in future studies.

Hypothesis 20, which is stating a positive relation between basic reflection and TMM-TM, is also partially supported by the data. Support is given with respect to positive relations between basic reflection and TMM about social and personal competencies of team members, but not with respect to TMM about meta competencies. The significant positive relations found in this thesis support the outlined arguments. By questioning basic assumptions, team members may learn something about each other's personal attitude towards and emotional involvement with the team's basic assumptions (personal competence), as well as each other's communicative and cooperative abilities while discussing and settling on basic assumptions (social competence) (see 3.3.1.). However, no significant relation was found between basic reflection and TMM-MC. It was supposed that basic reflection may foster TMM about meta competencies because team members may come to realize who has meta competencies in terms of, for example, analytical abilities or the ability to be factual in discussions, through reflecting basic assumptions (see 3.3.1.). A possible explanation why no significant relation was found may be that there are also other abilities assigned to the concept of meta competence, for which it is less plausible that team

members develop TMM-MC concerning the distribution of these abilities in the team through activities of basic reflection. For example, basic reflection may not reveal any information about individual team members' abilities with respect to multi-tasking, planning, or organizing, which are also meta competencies (see 2.1.2.1., Appendix A.2.), since the relation of these abilities with issues of basic reflection might not be given or not be as straightforward as in case of, for example, individuals' analytical abilities. Consequently, basic reflection may fail to support TMM-MC with respect to all of its ingredients. The positive but non-significant relation between basic reflection and TMM-MC that was found in this study may be interpreted as a hint that basic reflection fosters TMM about team members' meta competencies with respect to some aspects of TMM-MC (e.g. analytical/reflective abilities), but not with respect to all of the abilities assigned to the concept of meta competence. However, it is up to future research to empirically investigate this issue.

No relation was found between basic reflection and TMM-OC. This result is in line with the formulated expectation that team members might not significantly learn about each other's occupational competencies through basic reflection. Occupational competencies are supposed to have little relevance for basic reflection as they consist of individual expert knowledge that presumably is too specialized to relate to the more comprehensive issues of basic reflection (see 3.3.1.). Consequently, only sparse (if any) information about the occupational competencies of team members may be derived from the process of basic reflection. Nevertheless, the result found in this study seems to contrast study results by Dayan and Basarir (2010), who found a positive relation between team reflexivity, encompassing the notions of task reflection and basic reflection, and TMS. However, the measure of team reflexivity applied by Dayan and Basarir does not capture the construct of basic reflection in isolation, as the scale is unidimensional and mirrors the notions of both, task reflection and basic reflection. Therefore, it is not possible to determine to what extent the relationship found in their study bears upon the notion of basic reflection.

Like Hypotheses 18 and 19, Hypothesis 21, stating a positive relation between team process reflection and TMM-TM, is supported with respect to TMM about social, meta, and personal competencies of team members, but not with respect to TMM about occupational competencies. The found significant positive relations are in line with the presented theoretical argument that team process reflection supports the refinement of shared knowledge about team member competencies (Lewis et al., 2005; Oertel & Antoni, 2015; see 3.3.1.). However, contrary to what was expected, team process reflection was not related to TMM-OC. A possible explanation for this result might be that the relation between team process

reflection and TMM-OC is moderated by the current developmental stage of the team (as it is possibly also the case with respect to the relations of knowledge sharing and task reflection with TMM-OC). As already indicated, Oertel and Antoni (2015) found that the impact of team learning activities on TMS development depends on the current stage of team development. Hence, the relation between team process reflection and TMM-OC may be affected by team development, whereas team process reflection activities are possibly more relevant for TMM-OC in later developmental stages (Oertel & Antoni, 2015). In future research, studies investigating the moderating role of team development in the relation between team learning activities and TMM-OC are necessary to investigate this question.

Study results show that storage and retrieval has no effect on TMM-TM. This result is in line with the formulated expectation that storage and retrieval by use of material repositories is not related to TMM-TM, as it is not primarily performed via face-to-face interaction (see 3.3.1.). Results found in this study support the assumption that face-to-face interaction is required for TMM-TM to emerge. Previous research on the construct of TMS also supports this assumption (Hollingshead, 1998; Lewis, 2004). However, in contrast to these results, there are also studies demonstrating that electronic communication might have positive effects on TMS (Kanawattanachai & Yoo, 2007; Peltokorpi, 2004). In addition, Oertel and Antoni (2015) found that storage and retrieval by use of material repositories positively affects TMS in early stages of team development. Thus, at least with respect to TMM-OC, which conceptually overlaps with TMS, the effect of storage and retrieval might be moderated by the stage of team development. However, it is up to future organizational research to test this assumption.

Concerning the found results that team learning activities and TMM-OC are not significantly related, another possible reason for the discrepancy between the results of this study compared to studies on TMS, which mainly report positive relations between team learning activities and TMS (e.g. Dayan & Basarir, 2010; Oertel & Antoni, 2015; Yuan et al., 2010), might be the fact that the construct of TMS does not equal the construct of TMM-OC. The two constructs differ with respect to their conceptualization and measurement. Apart from the conceptual overlap regarding shared knowledge about team members' occupational competencies, TMS conceptually encompasses dimensions that are distinct from TMM-OC, e.g. team members beliefs about the reliability of teammates' occupational competencies (see 2.4.). Concerning construct measurement, within organizational settings TMS is mainly investigated with Likert-type scales (e.g. Akgün et al., 2005; Dayan & Basarir, 2010; Oertel & Antoni, 2015) or, less often, with team member ratings of individual team member

competencies with respect to prespecified fields of expertise (e.g. Yuan et al., 2010). These measurement techniques do not attain to capture shared knowledge with respect to content and structure, which is required for an accurate measurement of TMM (Mohammed et al., 2010). In this study, a qualitative approach encompassing Carley's (1997) cognitive mapping method has been applied for the measurement of TMM-TM with respect to content and structure (see 4.2.2.1.). Thereby, associations between teammates and competencies where not prespecified, but had to be freely generated by participants. Thus, the applied measurement method of TMM-TM essentially differs from TMS measures since no pre-assembled response options were given and since the measurement of shared knowledge with respect to content and structure was intended. Considering these differences, it is proposed that study results are not at odds with studies investigating the relations between team learning activities and TMS, as TMS and TMM-OC are different constructs with respect to their conceptualization and measurement.

Concerning the investigated control variables, two constant results were found in the analysis. (1) Team size positively predicts TMM-SC and (2) teamwork time positively predicts TMM-OC. Other significant paths between control variables and TMM-TM variables were not constant throughout Path Models 2-5 and, hence, appear somewhat arbitrary. Therefore, only the two constant results are discussed. (1) It was supposed that TMM-TM should decrease with increasing team size (see 3.3.3.). However, the contrary was found with respect to TMM about team members' social competencies. An explanation for this result might be that with increasing team size the amount of social interaction in the team also increases, and, hence, team members have more opportunities to learn and develop shared knowledge about each other's social competencies. Another explanation might be that social competencies are more present and perceived to be more important in larger teams, simply because there are more individuals that need to collaborate. Consequently, more TMM knowledge about team members' social competencies might be generated by the team.

(2) The result that teamwork time positively predicts TMM-OC is in line with the assumption that the amount of time the team is currently working together on the common task is positively related to TMM-TM (see 3.3.3.). Furthermore, teamwork time was the only significant predictor of TMM-OC. This suggests that working together on the common task is crucial for TMM about team members' occupational competencies to emerge. As study results indicate that the emergence of TMM-OC may not depend on the investigated team learning activities, the question arises, what aspects of the common work process foster this kind of shared knowledge to emerge. One possibility, apart from team learning activities, how

team members might learn about each other's occupational competencies while working together on the common task, is that they recognize each other's occupational competencies through observing each other's task performance. Another explanation may be derived from the empirical literature on the emergence of TMS. Several studies found that communication frequency in teams predicts TMS emergence (Lewis, 2004; Kanawattanachai & Yoo, 2007; Peltokorpi & Manka, 2008). Thus, communication frequency might also foster TMM-OC. However, focusing on quantitative measures assessing only the amount of intra-team communication, but not its quality, these studies give either no or only very limited information on the content of communication yielding TMS emergence. In other words, these studies give no information what kind of intra-team communication may foster the emergence of shared knowledge structures concerning team members' occupational competencies. In addition, as has been pointed out, it is questionable whether implications for TMM-OC may be derived from studies on the construct of TMS, since TMM-OC and TMS are not identical. Therefore, it is up to future research to further investigate the question what aspects of working on the common task may foster TMM-OC.

With respect to Research Question 4 (How is TMM-TM related to team performance?), no support was found for Hypothesis 22, stating a positive relation between TMM-OC and team performance with respect to effectiveness, efficiency, and innovativeness. This result seems to be in contrast with TMS theory, proposing that shared knowledge about team members' occupational competencies positively affects team performance (e.g. Chatterjee, 2016; Ellis et al., 2008; Moreland, 1999; see 3.3.2.). Moreover, the positive relation between TMS and team performance has been demonstrated in numerous empirical studies (e. g. DeChurch & Mesmer-Magnus, 2010; Huang et al., 2013; Kozlowski & Ilgen, 2006; Oertel & Antoni, 2015). However, as outlined above, the construct of TMS does not equal TMM-OC. Despite some conceptual overlap, there are essential differences between the constructs with respect to their conceptualization as well as measurement. Thus, insights from the TMS literature might not be at odds with the results found in this study. Study results indicate that shared knowledge about team members' occupational competencies is not sufficient to support team performance. Drawing on TMS theory, it is suggested that TMM knowledge on team members' occupational competencies needs to be complemented by a shared sense of credibility with respect to that TMM knowledge, in order to enhance team performance (e.g. Lewis, 2003; Chatterjee, 2016). Only if team members share the belief that the occupational competencies of their teammates are reliable, they may capitalize on the occupational resources embedded in their team mates. Consequently, TMM about team

members' occupational competencies may only support team performance, if it is complemented by that shared sense of credibility. However, it is up to future research to empirically test this assumption.

No significant results were found with respect to Hypothesis 23, stating a positive relation between TMM-SC and team performance with respect to effectiveness and efficiency. This contrasts the assumption that TMM-SC might improve team effectiveness and efficiency by enhancing the flow of information in the team (see 3.3.2.). Study results might be explained by considering the complexity of work tasks. In case of a less complex task, for example, if a team member needs to resolve a problem that already has been solved by other team members, TMM-SC may help the team member to identify those colleagues, who have the social competencies to communicate their advice in an understandable and helpful fashion. However, teams in the sample were dealing with complex, unstructured, and non-routine tasks, requiring the team to solve problems in innovative and creative ways (Carter & West, 1998; Devine, 2002; West, 1996). Holding TMM knowledge about team members' social competencies, e.g. about their cooperative or communicative skills, may not suffice to foster effectiveness and efficiency given these kind of tasks. It is difficult to think of ways how TMM-SC may help in the generation of creative and innovative solutions that are new to the team, since TMM knowledge about team members' social competencies may neither foster the team's engagement in learning processes nor may it empower the team to take the risk of failure. Accordingly, no relation was found between TMM-SC and team innovativeness. Therefore, it is proposed that TMM about team members' social competencies is not sufficient to enhance team performance in complex decision-making teams.

In contrast to Hypotheses 22 and 23, Hypothesis 24, stating a positive relation between TMM-MC and team performance with respect to effectiveness, efficiency, and innovativeness, was fully supported by the data. The found positive relations underpin the theoretical argument that, enhancing implicit coordination in the team, TMM-TM fosters team performance (Cannon-Bowers & Salas, 1990, 2001; Mathieu et al., 2000; Mohammed et al., 2010; DeChurch & Mesmer-Magnus, 2010; Rico et al., 2008; see 2.3.1., 3.3.2.). However, TMM-MC was the only TMM-TM variable that positively predicted all investigated team performance variables. Therefore, it is proposed that TMM knowledge about team members' meta competencies is a key component of the team's TMM-TM. The found significance of TMM-MC with respect to team performance might be due to the type of tasks that teams investigated in this study were dealing with. Meta competencies are especially important for

teams dealing with tasks that are complex, unstructured, and non-routine, as these competencies can flexibly be used in various situations and are necessary to deal with complex and novel tasks (Sonntag & Schmidt-Rathjens, 2004; Mulder & Gruber, 2011). Thus, given the importance of meta competencies for this type of tasks, it is suggested that TMM knowledge about team members' meta competencies may crucially foster intra-team coordination in complex decision-making teams, as team members may use these shared knowledge structures to capitalize on each other's meta competencies when dealing with tasks that are complex, unstructured, and non-routine. Consequently, TMM-MC may enhance effective, efficient, and innovative team performance in complex decision-making teams.

With respect to Hypothesis 25, TMM-PC was found to be a positive predictor of team innovativeness. This result underpins the argument that TMM knowledge about competencies regarding personal dispositions, e.g. attitudes, moral values, and motives that reinforce a persons' motivational and emotional involvement in the team's vocational task, might support team innovativeness, as TMM-PC encompasses shared knowledge regarding team members' commitment to the realization process of team innovativeness (see 3.3.2). Hence, the readiness to take and overcome risks and strains associated with the process of team innovation may be enhanced if TMM-PC is pronounced, because it indicates that team members are committed to the realization process of team innovativeness. However, different than expected, no significant relations were found between TMM-PC and the team performance dimensions of effectiveness and efficiency. Thus, whereas TMM about team members' personal competencies may support team innovativeness, it appears to have no effect on team effectiveness and efficiency. It has been argued that TMM-PC may enhance effectiveness and efficiency by enabling the team to assign tasks and roles in accordance with team members' achievement potential (see 3.3.2). Accordingly, for TMM-PC to effectively support effectiveness and efficiency, the team would be required to capitalize on that knowledge when assigning tasks and roles. However, other factors might be more decisive for the assignment of tasks and roles than shared knowledge about team members' personal competencies, for example, hierarchies in the team or team members' educational level and vocational background. As a consequence, TMM-PC may be ignored in the assignment of tasks and roles and, hence, fail to support team effectiveness and efficiency.

In addition to testing the formulated hypotheses, it was tested whether TMM-TM mediates between team learning activities and team performance. As team learning activities are hypothesized to be positively related to TMM-TM, and TMM-TM is hypothesized to be positively related to team performance, TMM-TM may be envisioned as a mediator between

team learning activities and team performance (Hayes, 2013). Results show mediation effects of TMM-MC and TMM-PC. TMM-MC mediates the relations of knowledge sharing, task reflection, and team process reflection with team efficiency, as well as the relation between knowledge sharing and team effectiveness. TMM-PC mediates the relations of task reflection and basic reflection with team innovativeness. Taken together by summing up their indirect effects, TMM-MC and TMM-PC mediate the relations of knowledge sharing, task reflection, and team process reflection with team innovativeness. These results suggest that the team learning activities of knowledge sharing, task reflection, basic reflection, and team process reflection may support team performance with respect to effectiveness, efficiency and innovativeness by fostering TMM about meta and personal competencies of team members.

### 5.3.2. Study limitations and future research directions

Seven limitations of the study that are specific to the investigation of Research Questions 3 and 4 are pointed out and future research directions are derived. (1) The possible impact of team development on the relations between team learning activities and TMM-TM was not investigated. Study results by Oertel and Antoni (2015) suggest that, at least with respect to TMM about team members' occupational competencies, the team's developmental stage might be crucial with respect to these relations. In future research, this limitation might be overcome by longitudinal studies investigating the relations between team learning activities and TMM-TM as a function of team development.

(2) The presented theoretical arguments propose that TMM-TM may enhance team performance through supporting processes of implicit team coordination (see 2.3.1., 3.3.2.). However, the mediating role of implicit team coordination is not investigated in this study. Hence, future research should investigate whether implicit coordination mediates between TMM-TM and team performance (Rico et al., 2008; Wildman et al., 2012).

(3) Study results may be limited because TMM-TM was measured only with respect to TMM similarity, but not with respect to TMM accuracy. TMM accuracy indicates whether TMM knowledge structures correspond with reality, in other words, through TMM accuracy it is assessed whether the knowledge shared in the TMM is true (Lim & Klein, 2006; Rentsch & Hall, 1994). Since accuracy has not been measured, study results may overestimate the importance of TMM-TM similarity (Mohammed et al., 2010; Smith-Jentsch, 2009). However, Gurtner et al. (2007) argue that similarity of team related TMMs may enhance team performance through improving team coordination, even if the contents of the TMM are not completely correct. In addition, Zajac et al. (2014) argue that in case of ill-defined tasks,

where there is no single correct task strategy, TMM similarity is more important than accuracy. Moreover, vocational competencies are not objectively given like, for example, the correct solution of an intellective task in a laboratory experiment (Argote et al., 2001). Vocational competencies substantially depend on and vary with the work context they are situated in (Mulder & Gruber, 2011; Sonntag & Schaper, 2006). Hence, assessing the correctness of TMM about individuals' vocational competencies would require an in depth analysis of the vocational competencies of each team member as situated in her or his respective teamwork context. Given the limited time teams had at their disposal for study participation, conducting this analysis was not possible in this study. In future research, qualitative studies may be conducted for an in depth analysis of TMM-TM accuracy in organizational work teams.

(4) It has been proposed that TMM about team members' occupational competencies may only support team performance if it is complemented by a shared sense of credibility regarding these competencies, meaning that team members share the belief that the occupational competencies of their teammates are reliable (e.g. Lewis, 2003; Chatterjee, 2016). However, this shared belief of credibility has not been investigated in this study. Thus, an interesting direction for future research might be to investigate credibility as a moderator between TMM-OC and team performance.

(5) TMM-TM was measured through team members freely recalling those vocational competencies of their team colleagues, which they considered to be relevant with respect to the common task. As a shortcoming of this method, it cannot be ruled out that team members are mistaken about the relevance of vocational competencies concerning their team's common task. Consequently, study results might be biased since team members may not refer to competencies that are important for team performance. However, as teamwork tasks were complex, unstructured, and non-routine and teams substantially differed with respect to their work fields and common tasks in this study, it was hardly possible to objectively determine the relevance of each vocational competency regarding each respective team. To avoid that team members refer to competencies that are irrelevant with respect to team performance, participants had to indicate for each single competence they assigned to each individual team colleague, how the respective team colleague applies the competence with respect to the common task. In future research, experimental studies with standardized tasks may be applied to objectively assess whether participants refer to task-relevant competencies.

(6) Modeling results regarding control variables differed to some extent between Path Models 2-5. This raises concerns about the stability of findings with respect to Research

Question 3 (Hypotheses 18-21). To examine the stability of findings, models were also tested without control variables (cf. Nijstad et al., 2014). However, testing the models without control variables, only Path Model 5 yielded an acceptable model fit and, thus, could be interpreted with respect to its estimates (see Appendix A.7.). Speaking in favor of stability, no deviant results were found with respect to Hypothesis 21.

(7) It has to be noted that study results concerning Research Questions 3 and 4 are tentative as existent theorizing on the construct of TMM-TM is sparse and studies investigating TMM-TM are lacking. Research and theorizing on TMS is a related field, but, as has been pointed out, there are substantial differences between TMM-TM and TMS. Consequently, the conducted modeling of relations with respect to TMM-TM regarding its four dimensions of vocational competence has somewhat explorative character. Further theorizing and research is necessary to fully explain these relations.

### 5.3.3. Practical implications

Concerning practical implications of the results investigating Research Questions 3 and 4, the constructs of TMM-MC and TMM-PC are mostly important as they were positively related to both, team learning activities and team performance. To foster team performance with respect to effectiveness, efficiency, and innovativeness in complex decision-making teams, teams may develop shared knowledge structures about meta competencies in the team, referring to team members' abilities that can flexibly be used in various situations and are necessary to autonomously deal with complex and novel tasks (Mulder & Gruber, 2011; Sonntag & Schmidt-Rathjens, 2004), e. g. the ability to solve problems or to apply analytical or creative thinking during task execution. Team members may use these shared knowledge structures to capitalize on each other's meta competencies when dealing with tasks that are complex, unstructured, and non-routine. In order to build up TMM-MC, the team may engage in the team learning activities of knowledge sharing, task reflection, and team process reflection.

Furthermore, study results suggest that team innovativeness might be fostered through the development of shared knowledge structures about team members' personal competencies, consisting of personal dispositions, e. g. attitudes, moral values, and motives, reinforcing a persons' motivational and emotional involvement in vocational tasks (Sonntag & Schaper, 2006). Distinct TMM about team members' personal competencies indicates that team members are motivationally and emotionally involved in the team's vocational task, and, hence, ready to take and overcome risks and strains associated with team innovativeness. The

team might build up TMM-PC through the team learning activities of knowledge sharing, task reflection, basic reflection, and team process reflection.

Drawing on the practical implications derived from the investigation of Research Questions 1, it is suggested that the team learning activities of knowledge sharing, task reflection, and team process reflection may be supported through establishing interdependent work structures and a safe team climate, as well as by avoiding the perception of strong team expert roles. Interdependent work structures may also foster basic reflection. In addition, large team size may be avoided to foster knowledge sharing and basic reflection. Practical implications derived from the investigation of Research Questions 2 further suggest that activities of team reflection may also be supported by the team leader through practicing a transformational leadership style.

Apart from performing team learning activities, shared knowledge structures about team members' meta and personal competencies might also be developed through directly addressing the issue of team member competencies in the team. This might be achieved, for example, by applying a teambuilding workshop. Deliberately guided discussion of team members' vocational competencies in the context of such a workshop may reinforce convergence of team members' perceptions of vocational competencies in the team. This should foster the development of TMM-TM and, consequently, team performance.

## 5.4. General Discussion

### 5.4.1. New insights derived from the study

The intention of conducting this research project was to take an encompassing look at organizational team learning by incorporating three basic dimensions of organizational team learning that are highlighted by contemporary theoretical models: (1) Activities, (2) products, and (3) antecedents of team learning (see 2.). Sketching the initial theoretical model, it has been drawn out that these three basic dimensions are either directly or indirectly linked with respect to their assigned variables (see 2.3.). For example, antecedents of team learning are directly linked to team learning activities, whereas team learning activities are directly linked to cognitive and behavioral team learning products. Cognitive and behavioral team learning products are also directly linked with each other. The aim of this empirical study was to contribute to the investigation of current research gaps with respect to relations between variables of these three basic dimensions of team learning. Some new insights regarding activities, products, and antecedents of team learning in organizational complex decision-making teams were gained.

With respect to Research Question 1, it has been investigated which beliefs about the team's interpersonal context are related to which team learning activity. Study results expand the existent knowledge by revealing a more detailed picture about the relations between interpersonal context beliefs and team learning activities. Applying a multidimensional measure encompassing five different team learning activities, distinct relations between different interpersonal context beliefs and team learning activities have become apparent. Furthermore, new insight is gained with respect to the interpersonal context variable of team expert roles, which has been neglected in existent theorizing and research on the antecedents of team learning activities. Study results suggest that the relations between interpersonal context beliefs and team learning activities are more complex than suggested by previous research and theorizing (e.g. Boon et al., 2013; Edmondson, 1999; Knapp, 2010; Van den Bossche et al., 2006; see 2.3.2.1., 2.4.). It turned out that all three investigated interpersonal context beliefs are important with respect to certain team learning activities under investigation, but only task interdependence was a significant predictor of all. Therefore, task interdependence is highlighted as a key component of team members' shared interpersonal context beliefs. Furthermore, it has been found that a safe team climate is not positively related to team learning activities in general, which has been proposed by previous research applying overarching unidimensional measures of team learning activities (e.g. Boon et al., 2013; Edmondson, 1999; Van den Bossche et al., 2006). Results of this study suggest that it depends on the kind of team learning activity under investigation whether a safe team climate supports a team learning activity or not. It has been found that a safe team climate may support knowledge sharing, task reflection, and team process reflection, but not basic reflection and storage and retrieval. Concerning the subjective perception of team expert roles, new insight is gained revealing that team expert roles are negatively related to the team learning activities of knowledge sharing, task reflection, and team process reflection.

With respect to Research Question 2, the mediating role of team reflection in the relation between transformational leadership and team innovativeness has been investigated. The study expands existent knowledge about the mediating processes between transformational leadership and team innovativeness by addressing the mediating role of team reflection as well as by investigating transformational leadership and safe team climate as moderators of this mediation. Though theoretical considerations as well as existent research are speaking in favor of team reflection mediating between transformational leadership and team innovativeness (see 2.3.1., 2.3.2.2., 2.4, 3.2.1.), to my knowledge, this is the first study to directly investigate this mediation. Furthermore, by investigating transformational leadership and safe team climate as

moderators of this mediation, the study adds to the newly emerging insights into combinations of factors supporting innovativeness in teams (e.g. Dayan & Basarir, 2010; Nijstad et al., 2014; Schippers et al., 2015). Study results suggest that team reflection mediates between transformational leadership and team innovativeness as rated by team members, and that transformational leadership moderates this mediation. However, no effects were found concerning team supervisor ratings of team innovativeness. It is suggested that these divergent results are explained by differences between team members' and team supervisors' perceptions of team innovativeness (see 5.2.1.).

Concerning Research Question 3, it has been investigated how team learning activities are related to TMM-TM. Thereby, the study adds to newly emerging insights about the relations between team learning activities and TMM (e.g. Gurtner et al., 2007; Van den Bossche et al., 2011). In particular, new insight is gained with respect to the relations between the investigated team learning activities and TMM about team members' vocational competencies (TMM-TM). It turned out that knowledge sharing, task reflection, and team process reflection positively predicted TMM-TM with respect to social, meta, and personal competencies, whereas basic reflection was positively related to TMM-TM concerning social and personal competencies. As expected, storage and retrieval was not related to TMM-TM.

With respect to Research Question 4, the relations between TMM-TM and team performance have been investigated. Despite the existence of a relatively solid research base investigating the link between TMM and team performance (see 2.3.1.), there is a lack of studies investigating whether and how TMMs with respect to team members' vocational competencies are related to team performance. This study adds to the literature on TMM and team performance by investigating this relation. It turned out that TMM-TM about meta (TMM-MC) and personal competencies (TMM-PC) are important with respect to team performance. TMM-MC predicted team effectiveness, efficiency, and innovativeness, whereas TMM-PC predicted team innovativeness. Furthermore, it has been found that TMM-MC and TMM-PC mediate between team learning activities and team performance.

### 5.4.2. General study limitations and future research directions

In addition to the limitations already discussed with respect to the respective research questions (see 5.1.2., 5.2.2., 5.3.2.), there are two limitations of the study that are not specific to the investigation of a specific research question, but rather apply to the study in general. (1) Decisions whether variables in the study are investigated as dependent or independent variables are based on theoretical considerations concerning their causal relations. However,

due to cross sectional design, it was not possible to statistically test for the implied causality of relations. In future research, longitudinal studies in organizational settings may be applied to test the relations found in this study with respect to causality (see Zapf, Dormann & Frese, 1996).

(2) Using self reported data collected from team members, study result may be affected due to response bias (Hülsheger et al., 2009). Though *ICC*s and mean $r_{wg}$ values indicate that self reports converge considerably at the team-level, suggesting at least intersubjectivity (De Dreu, 2007), the application of more objective measures of team learning activities, e.g. video analysis of team interaction, is desirable. The development of appropriate measurement techniques and their successful application in organizational settings is a major challenge for future research in the field of organizational team learning.

### 5.4.3. Conclusion

The importance of team learning for team and organizational performance is highlighted in the literature on organizational learning and development (e.g. Senge, 1999; Sessa & London, 2008a; Moran, 2005; Kozlowski & Bell, 2008; Wilson et al., 2007). Consequently, much research has been conducted to gain a better understanding of the phenomena of organizational team learning. However, although some crucial insight has been provided by existent studies and theories, there is still a great need for further research and theorizing, since "collective learning in specific work contexts is not well understood, yet has become critical to organizational success" (Knapp, 2010, p. 285). Therefore, the overarching aim of this thesis was to contribute to a better understanding of team learning in organizational complex decision-making teams. The conducted study provides detailed insights concerning the interpersonal context as well as transformational leadership as antecedents of team learning activities. Practitioners may capitalize on these insights to support specific team learning activities. Moreover, researchers may build on the findings of this study in their theorizing and research about team learning activities and associated antecedents.

Furthermore, the thesis highlights TMMs about team members' vocational competencies to be team cognitions that are crucial with respect to team performance. In addition, the study contributes to the emerging empirical literature investigating the research gap of how team cognition is formed (DeChurch & Mesmer-Magnus, 2010; Wildman et al., 2012). The construct of TMM-TM has largely been neglected in previous team cognition research, and, thus, constitutes an "area of opportunity for team cognition researchers" (Wildman et al., 2012, p. 108). In future research, further investigations into that direction are

especially important for practitioners. “This is a critical issue for those designing and using teams in applied settings. Given the important role emergent cognitive structures play, more research is needed to identify factors that promote the formation of functional cognitive structures” (DeChurch & Mesmer-Magnus, 2010, p. 49). However, due to a lack of existent theorizing and research on the construct of TMM-TM, the investigation of Research Questions 3 and 4 has somewhat explorative character. As a consequence, study results concerning TMM-TM remain tentative. Hence, the present study does not claim to fully explain the construct of TMM-TM and its relations with team learning activities and team performance, but may rather be considered as a starting point for further investigations into that direction.

Another important road for future research is the investigation of organizational team learning by applying longitudinal studies (DeChurch & Mesmer-Magnus, 2010; Wildman et al., 2012). Longitudinal research is necessary to investigate relationships between variables of team learning with respect to causality and to reveal temporal processes in organizational team learning. Finally, as the field of organizational team learning is extremely complex, with various types of teams (Devine, 2002), work fields, and organizational settings to be investigated, it becomes clear that there is still a long way to go until a comprehensive and valid understanding of the activities, products, and antecedents of organizational team learning may be reached.

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# A. Appendices

## A.1. Study Scales

| Constructs and scales | Items |
|---|---|
| **Team learning activities** | |
| Knowledge sharing | Wir geben projektrelevantes Know-how im Team weiter. |
| | Wir geben unser Vorwissen innerhalb des Teams weiter. |
| | Wir tauschen uns im Team über praktische Erfahrungen der Projektarbeit aus. |
| | Die Teammitglieder behalten ihre besten Ideen für sich.[r] |
| | Innerhalb des Teams teilen die Teammitglieder bereitwillig ihr Wissen/ ihre Ideen. |
| | Innerhalb des Teams teilen die Teammitglieder ihre Ideen offen mit. |
| | Die Teammitglieder mit Expertenwissen helfen bereitwillig anderen Teammitgliedern. |
| | Unser Team versteht es, Wissen und Ideen seiner Mitglieder zu nutzen. |
| Task reflection | Wir diskutieren verschiedene Möglichkeiten, wie wir unsere Vorgaben erreichen können. |
| | Wenn ein Teammitglied ein Problem entdeckt, spricht er/sie mit den anderen Teammitgliedern darüber. |
| | Wenn etwas nicht wie geplant läuft, überlegen wir, was wir diesbezüglich tun können. |
| | In unserem Team werden Probleme von verschiedenen Seiten betrachtet. |
| | *Wenn sich etwas nicht wie geplant entwickelt, dann nehmen wir uns als Team die Zeit, mögliche Problemursachen zu finden.* |
| Basic reflection | Unser Team überdenkt seine Ziele. |
| | Wenn sich die Bedingungen ändern, überdenken wir unsere Arbeitsmethoden. |
| | Wir hinterfragen unsere Ziele. |
| | Wir untersuchen, was wir von unseren bisherigen Erfahrungen für unsere jetzige Arbeit lernen können. |
| | *Wenn wir als Team erfolgreich sind, dann nehmen wir uns die Zeit zu analysieren, wie dieser Erfolg zustande gekommen ist.* |
| | *Wenn sich Bedingungen ändern prüfen wir, was das für unsere Gruppenziele bedeuten kann.* |
| | *Die vom Team zur Erfüllung des Auftrags eingesetzten Methoden werden diskutiert.* |
| Team process reflection | Wir diskutieren, ob das Team effektiv arbeitet. |
| | Wir diskutieren darüber, wie gut wir Informationen teamintern kommunizieren. |
| | Wir reflektieren darüber, wie wir Entscheidungen treffen. |
| | Wir reflektieren darüber, wie wir kommunizieren. |

*(Table continues)*

*(Table continued)*

| Constructs and scales | Items |
|---|---|
| Team reflection (unidimensional) | Wir diskutieren verschiedene Möglichkeiten, wie wir unsere Vorgaben erreichen können. |
| | In unserem Team werden Probleme von verschiedenen Seiten betrachtet. |
| | Wenn sich etwas nicht wie geplant entwickelt, dann nehmen wir uns als Team die Zeit, mögliche Problemursachen zu finden. |
| | Unser Team überdenkt seine Ziele. |
| | Wenn sich die Bedingungen ändern, überdenken wir unsere Arbeitsmethoden. |
| | Wir hinterfragen unsere Ziele. |
| | Wenn wir als Team erfolgreich sind, dann nehmen wir uns die Zeit zu analysieren, wie dieser Erfolg zustande gekommen ist. |
| | Wenn sich Bedingungen ändern prüfen wir, was das für unsere Gruppenziele bedeuten kann. |
| | Die vom Team zur Erfüllung des Auftrags eingesetzten Methoden werden diskutiert. |
| | Wir diskutieren, ob das Team effektiv arbeitet. |
| | Wir reflektieren darüber, wie wir Entscheidungen treffen. |
| | Wir reflektieren darüber, wie wir kommunizieren. |
| Storage and retrieval | Wir nutzen Teamdokumente, welche vom Team für das Team erstellt werden. |
| | Wir hinterlegen Teamdokumente in einem gemeinsamen Archiv. |
| | Wir speichern unser Wissen in einem gemeinsamen Archiv. |
| | Wir nutzen Teamdokumente zur Orientierung. |
| | *Wir fertigen Protokolle zu Teamsitzungen an.* |
| **Team performance – Team supervisor ratings** | |
| Team effectiveness | Das Team erzielt gute Leistungen. |
| | Das Team erreicht seine Ziele. |
| | Das Team entspricht den vorgegebenen Erwartungen. |
| | Ich bin zufrieden mit dem Team. |
| | Das Team leistet gute Arbeit. |
| | Die Arbeitsweise des Teams garantiert eine hohe Qualität der geleisteten Arbeit. |
| | *Das Team tut was es tun soll.* |
| | *Die Qualität der Arbeit des Teams ist zu bemängeln.*[r] |
| Team efficiency | Das Team arbeitet effizient. |
| | Das Team versteht es, Ziele schnell zu erreichen. |
| | Das Team betreibt unnötigen Aufwand. [r] |
| | Das Team nutzt die verfügbare Zeit gut. |

*(Table continues)*

*(Table continued)*

| Constructs and scales | Items |
|---|---|
| Team innovativeness | Das Team entwickelt neue und verbesserte Arbeitsweisen. |
| | Das Team entwickelt neue Arten mit Erwartungen des Vorgesetzten sowie der Teammitglieder umzugehen. |
| | Das Team entwickelt neue Konzepte. |
| | *Das Team versteht es, eine immer bessere Art zu finden, die Arbeit durchzuführen.* |
| **Team performance – Team member ratings** | |
| Team innovativeness | Unser Team entwickelt neue und verbesserte Arbeitsweisen. |
| | Unser Team entwickelt neue Arten mit Erwartungen des Vorgesetzten sowie der Teammitglieder umzugehen. |
| | Unser Team entwickelt neue Konzepte. |
| | Unser Team versteht es, eine immer bessere Art zu finden, die Arbeit durchzuführen. |
| **Interpersonal context beliefs** | |
| Safe team climate | Die Leute in meinem Team sind in der Lage, Probleme und kritische Fragen anzusprechen. |
| | Ich habe den Eindruck, mich in dem was ich Mitgliedern meines Teams gegenüber äußere vorsichtig verhalten zu müssen.[r] |
| | Bei der Arbeit in meinem Team besteht unter den Kollegen/innen ein vertrauensvolles Verhältnis. |
| | Bei der Arbeit in meinem Team geht man unter den Kollegen/innen fair miteinander um. |
| | Bei der Arbeit in meinem Team hält man unter den Kollegen/innen zusammen. |
| | Die Leute, mit denen ich im Team zusammenarbeite, mögen mich nicht besonders.[r] |
| | Bei der Arbeit in meinem Team bestehen unter den Kollegen/innen Konflikte und Spannungen.[r] |
| | Bei der Arbeit in meinem Team besteht unter den Kollegen/innen gegenseitige Achtung und Anerkennung. |
| | Es ist schwierig, Mitglieder meines Teams um Hilfe zu bitten.[r] |
| | Wenn jemand in meinem Team einen Fehler gemacht hat, kann er die anderen um Rat fragen, wie es weitergehen soll. |
| Task interdependence | Um Aufgaben im Projekt gut erledigen zu können, muss ich eng mit meinen Teammitgliedern zusammenarbeiten. |
| | Um Aufgaben im Projekt gut erledigen zu können, muss ich meine projektbezogenen Arbeitsaktivitäten mit meinen Teammitgliedern abstimmen. |

*(Table continues)*

*(Table continued)*

| Constructs and scales | Items |
|---|---|
| | Um Aufgaben im Projekt gut erledigen zu können, benötigen meine Teammitglieder Informationen von mir. |
| | Um Aufgaben im Projekt gut erledigen zu können, benötige ich Informationen von meinen Teammitgliedern. |
| | Um Aufgaben im Projekt gut erledigen zu können, ist es notwendig, dass alle Teammitglieder ihre Aufgaben gut erledigen. |
| | Um Aufgaben im Projekt gut erledigen zu können, benötige ich Rat von meinen Teammitgliedern. |
| Team expert roles | In unserem Team besitzen die einzelnen Mitglieder unterschiedliches projektrelevantes Expertenwissen. |
| | Manche Teammitglieder besitzen projektrelevantes Expertenwissen, das kein anderes Teammitglied besitzt. |
| | In unserem Team sind verschiedene Mitglieder als Experten für verschiedene Projektbereiche verantwortlich. |
| | In unserem Team benötigen wir das spezialisierte Fachwissen verschiedener Teammitglieder, um das Projekt erfolgreich durchführen zu können. |
| **Transformational leadership** | |
| | Die Führungskraft meines Teams kommuniziert eine klare und positive Vision der Zukunft. |
| | Die Führungskraft meines Teams behandelt die Mitarbeiter als Individuen und unterstützt sowie ermutigt sie in ihrer Entwicklung. |
| | Die Führungskraft meines Teams ermutigt die Mitarbeiter und zeigt ihnen gegenüber Anerkennung. |
| | Die Führungskraft meines Teams fördert Vertrauen, Mitarbeit und Kooperation unter ihren Mitarbeitern. |
| | Die Führungskraft meines Teams ermutigt dazu, Probleme auf neue Art zu überdenken und hinterfragt Annahmen kritisch. |
| | Die Führungskraft meines Teams macht ihre Werte deutlich und handelt gemäß ihrer Aussagen. |
| | Die Führungskraft meines Teams ruft in anderen Stolz sowie Respekt hervor und inspiriert mich durch ihre hohe Kompetenz. |
| **Control Variables** | |
| Information processing | Die Arbeit im Team erfordert, dass wir eine große Menge an Informationen überwachen. |
| | Die Arbeit im Team erfordert, dass wir viel nachdenken. |
| | Die Arbeit im Team erfordert, dass wir über mehrere Dinge gleichzeitig den Überblick behalten. |
| | Die Arbeit im Team erfordert, dass wir viele Informationen analysieren. |

*(Table continues)*

*(Table continued)*

| Constructs and scales | Items |
|---|---|
| Problem solving | Die Arbeit im Team beinhaltet das Lösen von Problemen, für die es keine eindeutig richtige Lösung gibt. |
| | Die Arbeit im Team erfordert, dass wir kreativ sind. |
| | Die Arbeit im Team beinhaltet das Lösen von Problemen, denen wir zuvor nicht begegnet sind. |
| | Die Arbeit im Team erfordert spezifische Ideen oder Lösungen für Probleme. |

*Note.* r = reverse scored. Items printed in italics were discarded.

## A.2. Category system for coding vocational competencies

### Personal Competence

| Category | Description | Coding samples |
|---|---|---|
| Unbefangenheit | Fähigkeit zur neutralen Bewertung von Gegebenheiten | „Neutraler Blick von außen“ |
| Disziplin | Pflichtbewusstes sowie ordentliches Verhalten | „Pflichtbewusstsein“ |
| Gelassenheit | Fähigkeit, in stressigen Situationen Ruhe zu bewahren | „Bleibt ruhig, ruhender Pol“ |
| Erfahrenheit / Lebenserfahrung | Fähigkeit zur Bewertung von Gegebenheiten aus einer reifen, lebenserfahrenen Perspektive | „Weisheit“ |
| Motivation | Motivierte Einstellung; Leistungswille | „Sehr hohe Arbeitsmotivation“ |
| Sympathie / Humor / positives Denken | Fähigkeit, eine positive Einstellung zu zeigen; Fähigkeit zum humorvollen und sympathischen Umgang im Kollegenkreis | „Immer gut gelaunt“ |
| Beweglichkeit/Flexibilität | Fähigkeit, spontan auf Situationen zu reagieren | „Situationsorientiertes Arbeiten“ |
| Loyalität | Fähigkeit, die Werte und Ziele des Teams zu teilen und zu vertreten | „Steht hinter der gemeinsamen Entscheidung“ |
| Glaubwürdigkeit | Fähigkeit, eigene Ansichten ehrlich gegenüber anderen zu äußern | „Ehrlichkeit“ |
| Verantwortungsbewusstsein | Fähigkeit zur Übernahme von Verantwortung | „Fühlt sich für ihre Aufgaben verantwortlich“ |
| Normativ-ethische Einstellung | Fähigkeit zum wertbasierten Umgang mit Kollegen und Leistungsempfängern des Teams. Insbesondere Fähigkeiten in folgenden Bereichen: Toleranz/Akzeptanz; Fairness | „Verurteilt nicht“; „Fair und gerecht“; |
| Selbstsicherheit | Fähigkeit, selbstsicher aufzutreten | „Selbstbewusstsein“ |
| Selbstreflexion | Fähigkeit zur Reflexion des eigenen Handelns | „Reflexion des eigenen Handelns“ |
| Umsetzungskompetenz | Fähigkeit, die eigene Arbeitskraft produktiv und in Übereinstimmung mit den Zielen des Teams zum Einsatz zu bringen. Insbesondere Fähigkeiten in folgenden Bereichen: Tatkraft/Engagement; qualitativ hochwertige Arbeitsergebnisse; eigenständige Aufgabenbearbeitung; Entscheidungsfähigkeit; Zielstrebigkeit | „Belastbar in schwierigen Situationen“; „Ehrgeiz“; „Engagement“; „Stets hervorragende Ergebnisse“; „Selbstständiges Arbeiten“; „Entscheidungsstark“; „Zielorientiertes Arbeiten“ |

**Social competence**

| Category | Description | Coding samples |
|---|---|---|
| Fürsorglichkeit | Fähigkeit, sich aktiv um das Wohlbefinden von Teamkollegen und Leistungsempfängern des Teams zu bemühen | „Berücksichtigt stets das Wohlbefinden anderer“ |
| Leitung | Fähigkeit, das Team unterstützend und zielorientiert zu führen. Insbesondere Fähigkeiten in folgenden Bereichen:<br>Koordination von Aufgaben; Beratung der Teammitglieder; zielorientiertes Führen; Vorbildfunktion; Förderung und Unterstützung der Teammitglieder | „Sinnvoll delegieren“; „Ratgeber bei Problemen“ ; „Vorgabe der Ziele und den Weg dorthin“; „Gute Vorbildfunktion“; „Setzt sich für unsere Anliegen ein“ |
| Kooperationsfähigkeit | Fähigkeit zur kooperativen Zusammenarbeit. Insbesondere Fähigkeiten in folgenden Bereichen:<br>Anpassungsfähigkeit/Integrationsfähigkeit; kooperatives Problemlösen; Zuverlässigkeit; Hilfsbereitschaft | „Anpassen an das vorhandene Team“; „Erarbeiten von Fragestellungen und lösen von Problem durch Besprechung“; „Zuverlässigkeit“; „Hilfsbereit“ |
| Teamfähigkeit | Fähigkeit, ein positives Kooperationsklima innerhalb des Teams zu fördern. Insbesondere Fähigkeiten in folgenden Bereichen:<br>Konfliktlösung; positive Beeinflussung von Teamklima/Arbeitsklima; Verständnisbereitschaft/Empathie; Wertschätzung | „Konfliktlösungsstrategien“ ; „Schafft positives Klima im Team“; „Versucht andere zu verstehen, kann gut zuhören“; „Wertschätzung der Arbeit“ |
| Grundlegende Kommunikationsfähigkeiten | Grundlegende kommunikative Fähigkeiten im Rahmen der Teamkooperation. Insbesondere Fähigkeiten in folgenden Bereichen:<br>Wissensweitergabe/Wissensaustausch; offene Kommunikation; Umgangsformen; Erreichbarkeit/Ansprechbarkeit | „Gibt ihr Wissen weiter“; „Offenheit in Gesprächen“; „Freundlichkeit“; „Immer ansprechbar“ |
| Gehobene Kommunikationsfähigkeiten | Kommunikative Fähigkeiten welche gehobenes Ausdrucksvermögen und/oder argumentatives Geschick erfordern. Insbesondere Fähigkeiten in folgenden Bereichen:<br>Diskussionsfähigkeit (Argumentation, Moderation, Probleme ansprechen); Durchsetzungsfähigkeit; Ausdrucksfähigkeit/fokussierte Sprache; Kundenorientierung/Kontakt zu Leistungsempfängern | „gute Argumentationskraft“; „Moderieren von Gesprächen“; „Durchsetzungsvermögen“; „Redegewandtheit“; „Hält den Kunden bei Laune“ |

## Meta competence

| Category | Description | Coding samples |
|---|---|---|
| Schriftsprachliche Fähigkeiten | Fähigkeit zum kompetenten schriftsprachlichen Ausdruck | „Kommunikation schriftlich“; „Schreibkompetenz“ |
| Lehrfähigkeit / Präsentationsfähigkeit | Fähigkeit zur Wissensvermittlung; Fähigkeit zur verständlichen Präsentation von Informationen | „Darstellungskompetenz“; „Präsentationsstärke“; „Lehrkompetenz“ |
| Multi-tasking | Fähigkeit, die eigene Aufmerksamkeit simultan auf verschiedene Aufgaben zu richten | „Kann an mehreren Projekten gleichzeitig arbeiten“ |
| Sachlichkeit / Professionalität | Fähigkeit zur sachlichen/professionellen Auseinandersetzung mit arbeitsbezogenen Themen | „Objektiv“; „Professionell“ |
| Problemlösefähigkeit | Fähigkeit, Problemlösungen zu finden | „Sie bringt Lösungsansätze auf die keiner kommt“ |
| Intuitive Expertise | Fähigkeit, intuitiv richtig zu handeln | „Erspürt gut Situationen“ |
| Gewissenhaftigkeit | Gründliche Arbeitsweise; korrektes und sorgfältiges Erledigen von Aufgaben | „Gründlichkeit, Genauigkeit“ |
| Systematisch-methodisches Vorgehen | Strukturierte und durchdachte Vorgehensweise bei Arbeitstätigkeiten | „sehr strukturiertes Arbeiten“ |
| Managementkompetenz | Fähigkeit zur Planung und Organisation von Aufgaben und Abläufen; Steigerung der Effizienz der Teamarbeit | „Zeitmanagement/Organisation“; „Gutes und sinnvolles Wirtschaften“ |
| Wissensorientierung / Lernbereitschaft | Interesse an neuem Wissen; Motivation, neue Kenntnisse und Fähigkeiten zu erwerben. Insbesondere Fähigkeiten in folgenden Bereichen: Wissbegier/Neugierde; Offenheit für Neues; Experimentierbereitschaft; Feedbackfähigkeit; Wissensaktualisierung | „Will die Hintergründe verstehen“; „Interessiert an Neuem“; „Probiert neue Dinge aus“; „Kritikfähig“; „Immer auf aktuellem Stand“ |
| Kreativität | Fähigkeit zum kreativen Umgang mit Arbeitsanforderungen. Insbesondere Fähigkeiten in folgenden Bereichen: Innovatives/unkonventionelles Denken; Kreativität/Ideenreichtum; Gestaltung/Visualisierung | „Unkonventionelle Ideen“; „Kreativität“; „Visualisierung von Ideen, Prozessen“ |
| Analytische Fähigkeiten / Intelligenz | Fähigkeiten im abstrakt-logischen Denken; Fähigkeit zur Analyse von Zusammenhängen. Insbesondere Fähigkeiten in folgenden Bereichen: Reflexionsfähigkeit; Folgebewusstsein; ganzheitliches Denken; Auffassungsvermögen | „Hinterfragt Gegebenheiten“; „Vorausschauendes Handeln/Denken“; „Überblick über Gesamtsituation“; „Probleme schnell verstehen“ |

## Occupational Competence

| Category | Description | Coding samples |
|---|---|---|
| Teambezogenes Metawissen | Wissen hinsichtlich arbeitsrelevanter Charakteristika der Teammitglieder | „Überblick über die vorhandenen Teamkompetenzen“ |
| Außerfachliches Arbeitswissen | Hintergrundwissen hinsichtlich der Organisationsstrukturen des Arbeitgebers | „Fachkompetenz in Bezug auf interne Abläufe“ |
| Fachübergreifende Kenntnisse | Kenntnisse aus mehreren verschiedenen Fachbereichen | „Steuert Erfahrungen aus unterschiedlichen Bereichen bei“ |
| Berufserfahrung | Praktische Erfahrung im Arbeitsbereich | „Erfahrung in Kundenprojekten“; „IT-Erfahrung“ |
| Spezifische Fachkompetenz / Fachwissen[1] | Spezifische Fachkompetenzen, welche auf den jeweiligen Arbeitsbereich des Teams bezogen sind; z.B. Programmierkenntnisse, kaufmännisches Fachwissen, technisches Fachwissen | „Know-How Konstruktion, Mechanik“; „Statistisches Fachwissen“; „Betreut Netzwerk und Software“ |

[1] The category of specific occupational competence entails further sub categories that were individually tailored for each single team. This was necessary because the specific occupational competencies of team members varied heavily between teams coming from different work fields.

## A.3. Tests of normal distribution of the variables in Path Model 1

| Variable | Kolmogorov-Smirnov-Test | | Shapiro-Wilk-Test | |
|---|---|---|---|---|
| | Coefficient | *p*-value | Coefficient | *p*-value |
| Team size | .11 | .04 | .93 | .00 |
| Team tenure | .23 | .00 | .69 | .00 |
| Safe team climate | .15 | .00 | .90 | .00 |
| Task interdependence | .11 | .02 | .90 | .00 |
| Team expert roles | .15 | .00 | .89 | .00 |
| Knowledge sharing | .10 | .08* | .96 | .02 |
| Task reflection | .11 | .02 | .96 | .02 |
| Basic reflection | .09 | .20* | .98 | .44* |
| Team process reflection | .06 | .20* | .98 | .35* |
| Storage and retrieval | .14 | .00 | .93 | .00 |

*Note.* $N_1$ = 75 teams.
* not significantly deviant from normal distribution, $p > .05$.

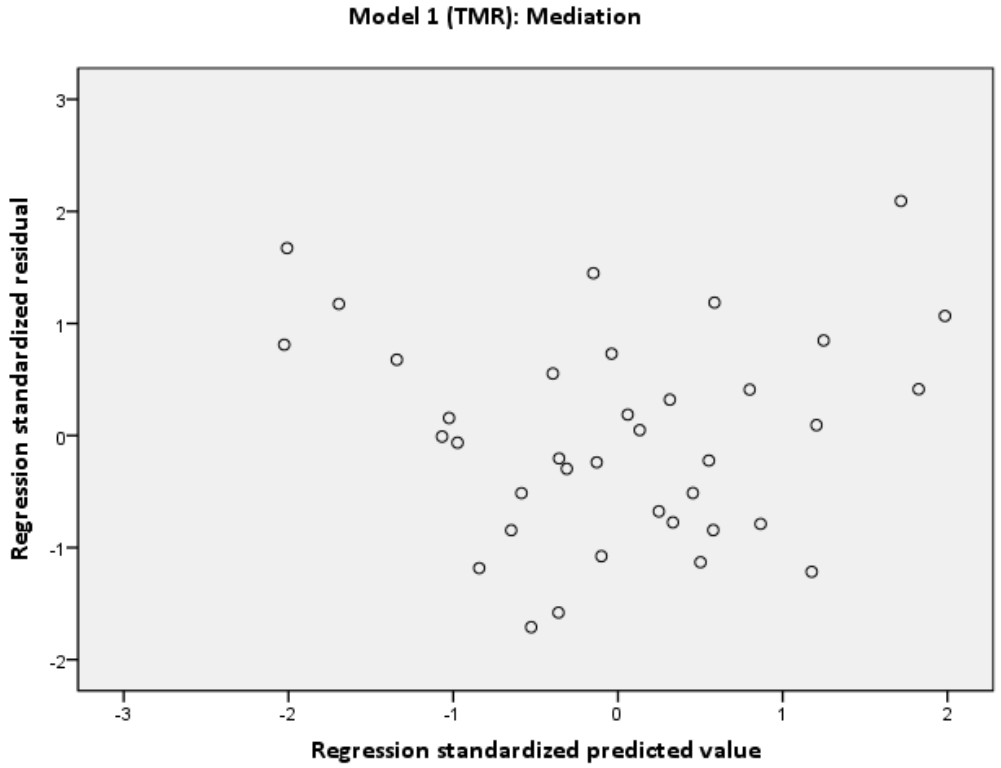
## A.4. Tests for assessing the model assumptions of Regression Models 1-6

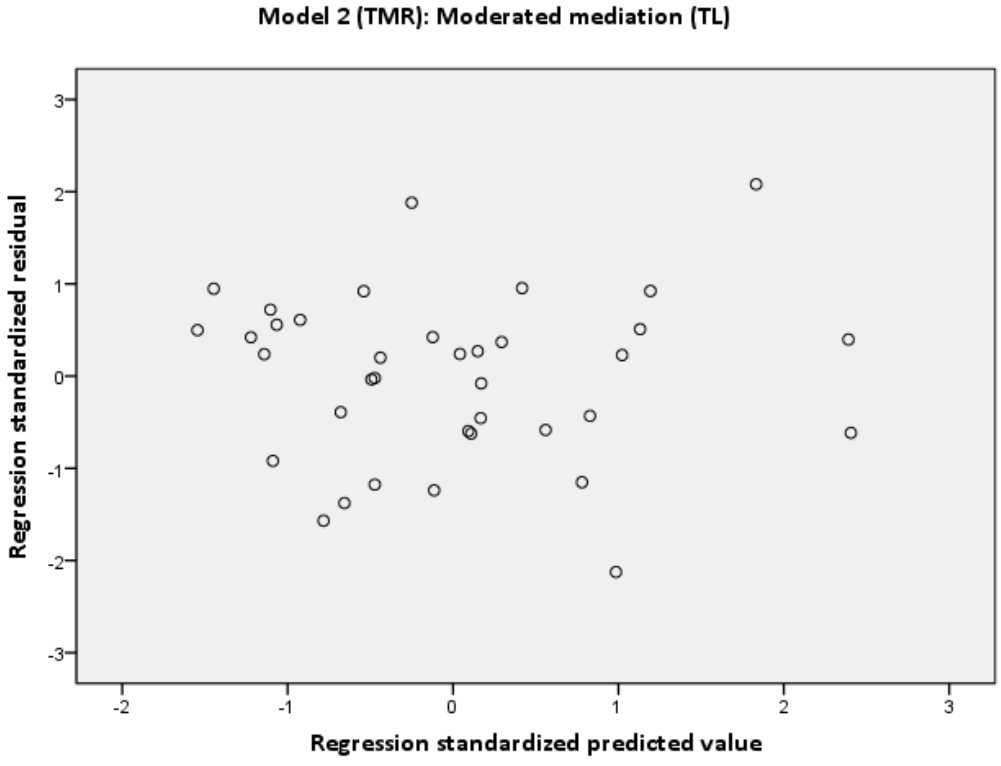
### A.4.1. Test of independence of error terms: Durbin-Watson coefficients

| Model | Durbin-Watson coefficient |
|---|---|
| Model 1 (TMR[1]): Mediation | 1.66 |
| Model 2 (TMR): Moderated mediation (TL) | 1.70 |
| Model 3 (TMR): Moderated mediation (STC) | 1.68 |
| Model 4 (TSR[2]): Mediation | 1.97 |
| Model 5 (TSR): Moderated mediation (TL) | 1.99 |
| Model 6 (TSR): Moderated mediation (STC) | 1.96 |

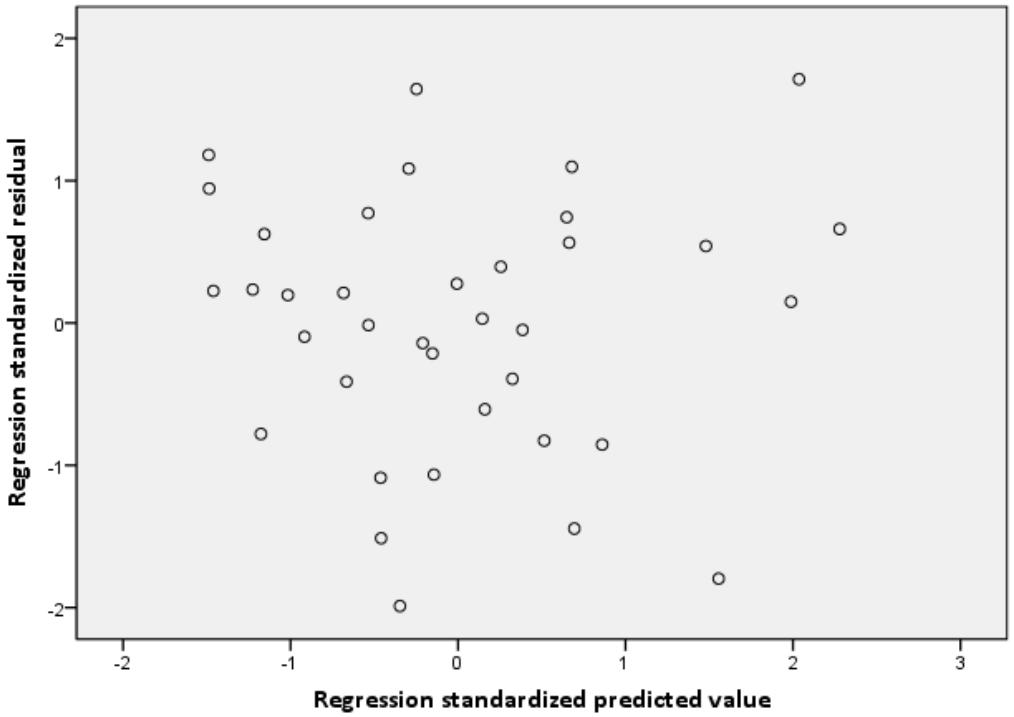
*Note.* $N_2$ = 37 teams.
[1]TMR = Team member ratings of team innovativeness.
[2]TSR = Team supervisor ratings of team innovativeness.

### A.4.2. Test of homoscedasticity: Scatterplots of residuals as function of predicted values

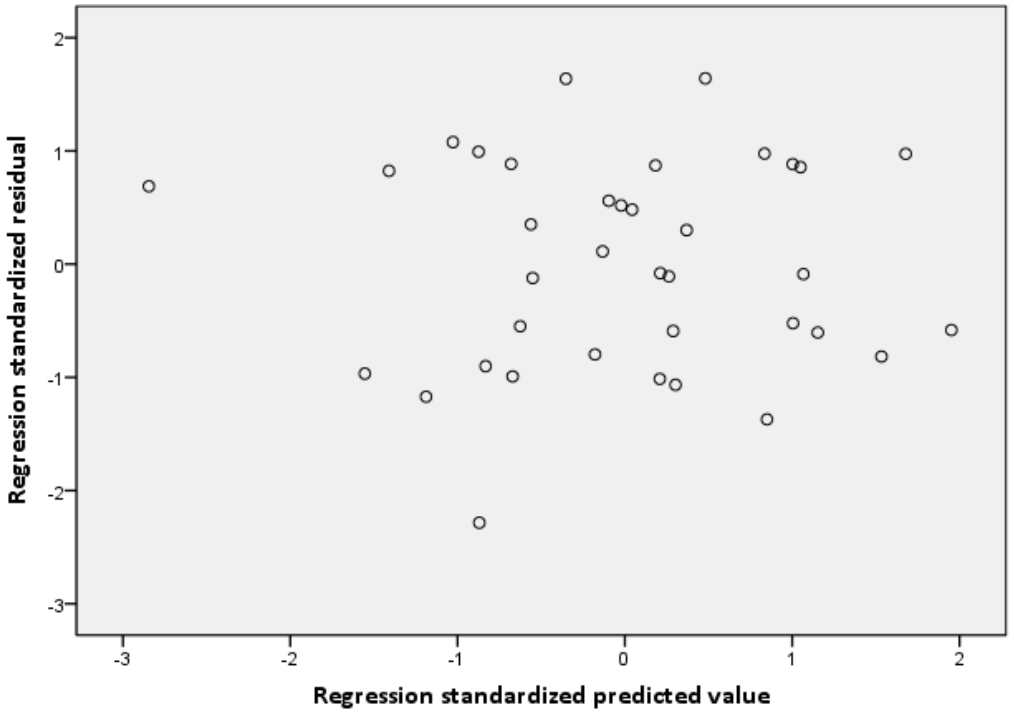


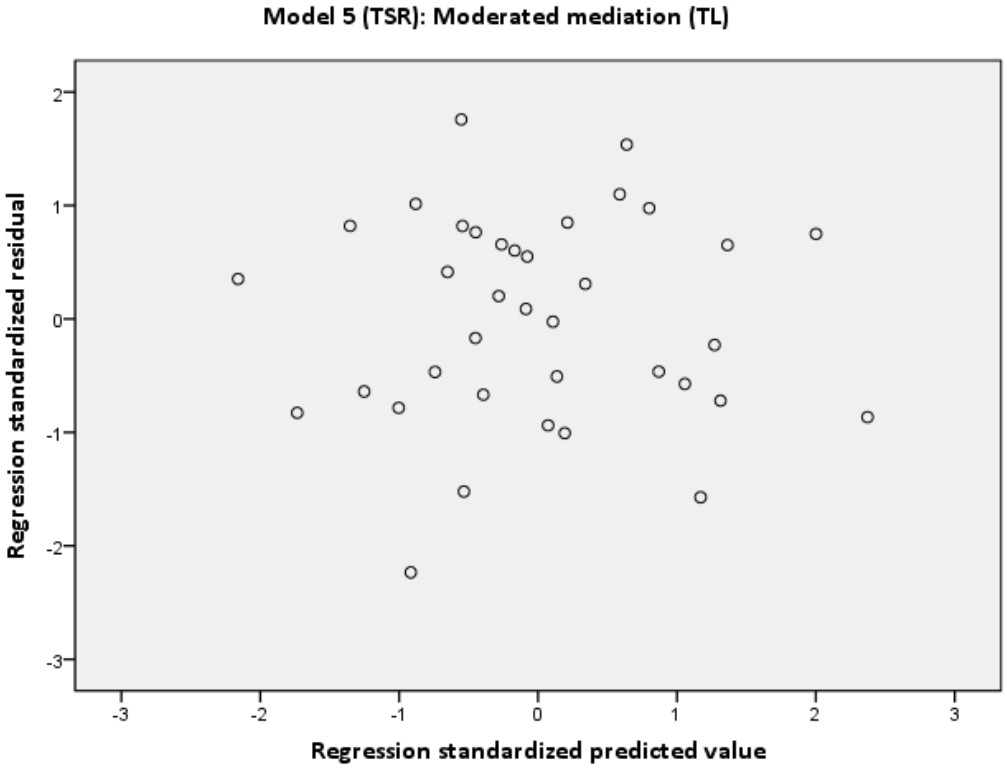



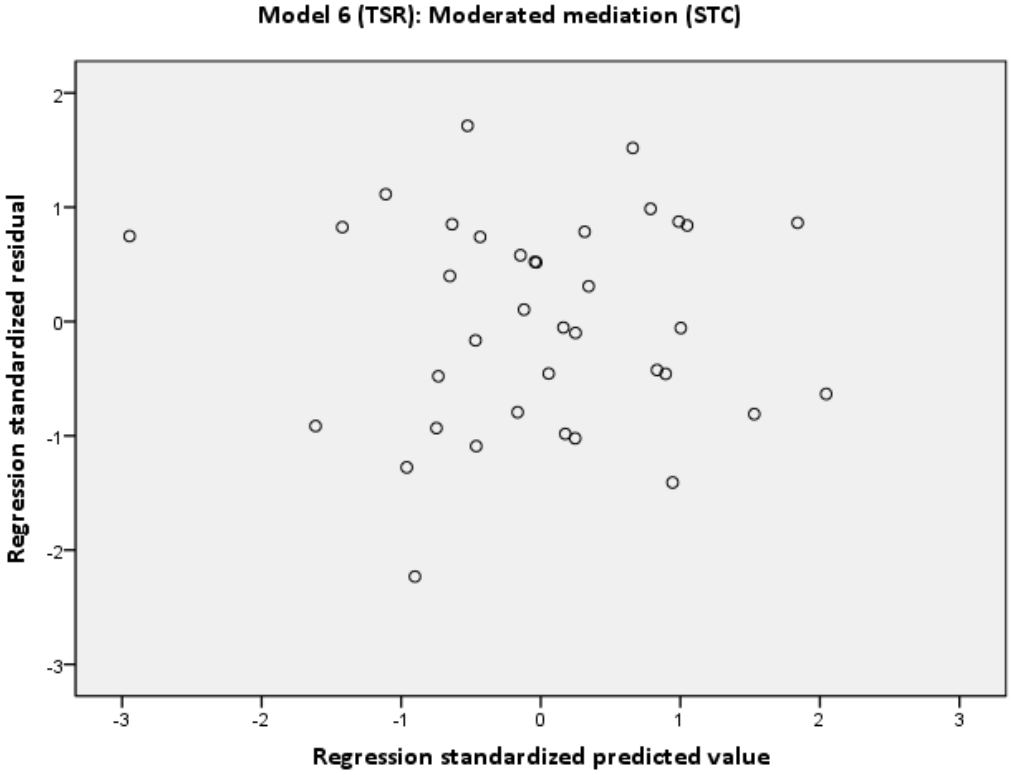
**Model 3 (TMR): Moderated mediation (STC)**




**Model 4 (TSR): Mediation**




Model 5 (TSR): Moderated mediation (TL)
Regression standardized residual
Regression standardized predicted value
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3


Model 6 (TSR): Moderated mediation (STC)
Regression standardized residual
Regression standardized predicted value
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3

## A.5. Regression models without additional covariates

*Regression Models Without Additional Covariates Testing for Indirect and Conditional Indirect Effects on Team Innovativeness-TMR*

| Predictor | | Regression Model 1: Mediation | Regression Model 2: Moderated mediation (TL) | Regression Model 3: Moderated mediation (STC) |
|---|---|---|---|---|
| Team Reflection (TR) | | .88** | .83** | .69** |
| Transformational Leadership (TL) | | .04 | .10 | .00 |
| Safe Team Climate (STC) | | | | .25 |
| TL x TR | | | 1.00* | |
| STC x TR | | | | .28 |
| Conditional effect at values of the moderator | *M*-1*SD* | | .32 | .54 |
| | *M* | | .83** | .69** |
| | *M*+1*SD* | | 1.34** | .85** |
| $R^2$ | | .45** | .55** | .50** |
| $\Delta R^2$ due to interaction | | | .10* | .01 |
| Indirect effect/ 95% bootstrap CI[1] | | .33/0.14-0.62 | | |
| Conditional indirect effect at values of the moderator/95% bootstrap CI | *M*-1*SD* | | .12/-0.02-0.39 | .21/-0.12-0.57 |
| | *M* | | .32/0.16-0.53 | .26/0.07-0.53 |
| | *M*+1*SD* | | .51/0.26-0.80 | .32/0.06-0.73 |
| Index of Moderated Mediation (*IMM*) / 95% CI | | | .38/0.14-0.74 | .11/-0.28-0.66 |

*Note.* $N_2$ = 37 teams. Dependent variable: Team member ratings (TMR) of team innovativeness. Unstandardized regression coefficients are reported.

[1] Bias corrected bootstrap intervals; 10,000 bootstrap samples.

*p < .05, ** p < .01.

*Regression Models Without Additional Covariates Testing for Indirect and Conditional Indirect Effects on Team Innovativeness-TSR*

| Predictor | | Regression Model 4: Mediation | Regression Model 5: Moderated mediation (TL) | Regression Model 6: Moderated mediation (STC) |
|---|---|---|---|---|
| Team Reflection (TR) | | .27 | .23 | .38 |
| Transformational Leadership (TL) | | .54† | .60* | .65* |
| Safe Team Climate (STC) | | | | -.23 |
| TL x TR | | | 1.01 | |
| STC x TR | | | | .30 |
| Conditional effect at values of the moderator | *M*-1*SD* | | -.29 | .21 |
| | *M* | | .23 | .38 |
| | *M*+1*SD* | | .75 | .54 |
| $R^2$ | | .20* | .23* | .23† |
| $\Delta R^2$ due to interaction | | | .04 | .00 |
| Indirect effect/ 95% bootstrap CI[1] | | .10/-0.19-0.55 | | |
| Conditional indirect effect at values of the moderator/95% bootstrap CI | *M*-1*SD* | | -.11/-0.54-0.68 | .08/-0.49-0.85 |
| | *M* | | .09/-0.19-0.54 | .14/-0.22-0.55 |
| | *M*+1*SD* | | .28/-0.14-0.72 | .21/-0.19-0.78 |
| Index of Moderated Mediation (*IMM*) / 95% CI | | | .38/-0.31-1.16 | .12/-0.67-0.95 |

*Note.* $N_2$ = 37 teams. Dependent variable: Team supervisor ratings (TSR) of team innovativeness. Unstandardized regression coefficients are reported.

[1] Bias corrected bootstrap intervals; 10,000 bootstrap samples.

†p<.10, *p < .05, ** p < .01.

## A.6. Alternative path models

*Model Estimates of Path Model 1.1*

| Predictors | Team learning activities | | | | |
|---|---|---|---|---|---|
| | Knowledge sharing | Task reflection | Basic reflection | Team process reflection | Storage and retrieval |
| Team size | -.31** | -.17 | -.21* | -.10 | -- |
| Team tenure | -- | -- | .06 | .10 | -- |
| Safe team climate | .63** | .46** | .12 | .21* | -.06 |
| Task interdependence | .19* | .30** | .36** | .35** | .44** |
| Team expert roles | -.15* | -.23* | .13 | -.23* | -.04 |

*Note.* $N_1$ = 75 teams. Standardized path coefficients are reported. Model fit: $\chi 2 = 2.64$, $df = 4$, $p = .62$; CFI = 1.00; TLI = 1.06; SRMR = 0.017; RMSEA = 0.000.

* $p > .05$, ** $p > .01$; two-tailed

*Model Estimates of Path Model 2.1*

| Predictors | Effectiveness | Efficiency | Innovativeness |
|---|---|---|---|
| TMM-OC | -.10 | -.18 | .07 |
| TMM-SC | .15 | -.03 | .04 |
| TMM-MC | .32** | .37** | .29* |
| TMM-PC | -.01 | -.06 | .20* |

Note. Model estimates are based on $N_4$ = 54 teams. Standardized path coefficients between TMM-TM variables and team performance variables are reported. Model fit: $\chi 2 = 16.02$, $df = 15$, $p = .38$; CFI = 0.99; TLI = 0.97; SRMR (between) = 0.079; RMSEA = 0.015.

* p > .05, ** p > .01; two-tailed.

*Model Estimates of Path Model 3.1*

| Predictors | TMM-OC | TMM-SC | TMM-MC | TMM-PC |
|---|---|---|---|---|
| Team size | -.08 | .44** | .13 | .30* |
| Teamwork time | .23 | .11 | .10 | .05 |
| Task reflection | -.22 | .48** | .28* | .56** |
| Storage and retrieval | .18 | -.28 | .14 | .01 |

Note. Model estimates are based on $N_3$ = 63 teams. Standardized path coefficients between predictors and TMM-TM variables are reported. Model fit: $\chi 2$ = 12.60, *df* = 19, *p* = .86; CFI = 1.00; TLI = 1.21; SRMR (between) = 0.051; RMSEA = 0.000.

* p > .05, ** p > .01; two-tailed.

*Model Estimates of Path Model 4.1*

| Predictors | TMM-OC | TMM-SC | TMM-MC | TMM-PC |
|---|---|---|---|---|
| Team size | -.05 | .38* | .09 | .39* |
| Teamwork time | .46** | -.28* | .09 | -.38* |
| Basic reflection | -.26 | .52* | .19 | .92** |

Note. Model estimates are based on $N_3$ = 63 teams. Standardized path coefficients between predictors and TMM-TM variables are reported. Model fit: $\chi 2$ = 16.16, *df* = 16, *p* = .44; CFI = 1.00; TLI = 1.00; SRMR (between) = 0.100; RMSEA = 0.006.

* p > .05, ** p > .01; two-tailed.

## A.7. Model estimates of Path Models 2-5 without control variables

*Model Estimates of the Between Teams Path Models 2-5 without control variables*

| | TMM-OC | TMM-SC | TMM-MC | TMM-PC | TMM-OC | TMM-SC | TMM-MC | TMM-PC |
|---|---|---|---|---|---|---|---|---|
| Predictors | Path Model 2 | | | | Path Model 3 | | | |
| Knowledge sharing | -.19 | .34† | .36** | .33† | | | | |
| Task reflection | | | | | -.14 | .30† | .24† | .43** |
| | Path Model 4 | | | | Path Model 5 | | | |
| Basic reflection | -- | .30 | .24† | .47** | | | | |
| Team process reflection | | | | | -.10 | .40* | .37* | .41** |

| | Team performance, Path Models 2-5 | | |
|---|---|---|---|
| Predictors | Effectiveness | Efficiency | Innovativeness |
| TMM-OC | -.10 | -.18 | .07 |
| TMM-SC | .13 | -.04 | -- |
| TMM-MC | .32** | .37** | .30* |
| TMM-PC | -.01 | -.05 | .21* |

*Note.* Model estimates between predictors and TMM-TM variables are based on $N_3 = 63$ teams; model estimates between predictors and team performance variables are based on $N_4 = 54$ teams. Standardized path coefficients are reported. Model fit Path Model 2: $\chi 2 = 13.98$, df = 10, p = .17; CFI = 0.95; TLI = 0.86; SRMR (between) = 0.095; RMSEA = 0.036; Path Model 3: $\chi 2 = 19.47$, df = 17, p = .30; CFI = 0.97; TLI = 0.94; SRMR (between) = 0.089; RMSEA = 0.022; Path Model 4: $\chi 2 = 15.84$, df = 10, p = .10; CFI = 0.92; TLI = 0.80; SRMR (between) = 0.101; RMSEA = 0.044; Path Model 5: $\chi 2 = 7.72$, df = 10, p = .66; CFI = 1.00; TLI = 1.09; SRMR (between) = 0.072; RMSEA = 0.000.

† p > .10, * p > .05, ** p > .01; two-tailed.

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