CHAPTER 7
General discussion

Teams need to be able to anticipate and respond to all kinds of new problems that arise from dynamic developments in our rapidly changing world (e.g. DeChurch & Mesmer-Magnus, 2010; Kozlowski & Ilgen, 2006). According to former research, the development of team cognition containing knowledge about the task facilitates this process and its results (Cannon-Bowers & Salas, 2001; DeChurch & Mesmer-Magnus, 2010; Kozlowski & Ilgen, 2006; Salas, Cooke, & Rosen, 2008; Salas & Fiore, 2004), indicating that the team's members need to be able "*to get on the same page*" concerning the problem they face and the best way to solve it. In this dissertation we argue that the use of team learning facilitates this process of getting on the same page.

This dissertation acknowledges two relatively unexplored areas in team cognition research. First, team cognition research has been mainly conducted with work teams that perform the actual day-to-day tasks in an organization, such as military combat teams (Lim & Klein, 2006), and air traffic control teams (Smith-Jentsch, Mathieu, & Kraiger, 2005). We extended this research by addressing a team type that has the intellectual task to take decisions based on information that it collects and integrates from a variety of sources (Devine, 2002). We studied the emergency management on-scene-command-team (OSCT) which is responsible for the coordination of the multidisciplinary assistance units acting at the scene of an incident, such as an airplane crash or a collision of cars on a highway. This multidisciplinary ad hoc command-and-control team coordinates the work units performing at the scene: the fire department, the police, and the medical assistance unit. Together these units and the OSCT function as a multi-team system ("two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals", Marks, Mathieu, & Zaccaro, 2001, p. 290). The goal for the OSCT is to collectively diminish the source of the crisis and control the consequences, while working under time pressure, guarding work place safety and preventing errors that may cause more damage and victims (Baker, Day, & Salas, 2006; La Porte, 1996). If the OSCT achieves this goal, then it can be typified as a high reliability team (HRT) that consistently, effectively and interdependently works towards a shared goal in a complex and dynamic environment, while working under high levels of stress (Wilson, Burke, Priest, & Salas, 2005).

The need to effectively deal with new problems and ever-changing circumstances is very important for the OSCT, which is confronted with unique emergency situations each time it operates. Therefore, the OSCT needs intra-crisis learning that improves its response to the incident while the crisis is still ongoing (Moynihan, 2009). Not only the environment of the OSCT is dynamic; so is the team itself. The OSCT has an ad hoc composition that may change during its short life span, and often consists of members that are unfamiliar with each other. We therefore hypothesized that developing shared knowledge about the task at hand is important in these teams to collectively learn how to respond to the specific situation at hand, thereby making use of the different exper-

tise available in the team. We approached the first aim of this dissertation this way: improving our understanding of intra-crisis learning.

As a second contribution to existing team cognition research, we approached team cognition as a dynamic phenomenon. Even though team cognition evolves over time, former research merely approached it as a crystallized structure. Researchers mostly use the concept of the team mental model (TMM) - the collectively owned long-term task-relevant knowledge developed during earlier experiences and team cooperation (Canon-Bowers, Salas, & Blickensderfer, 1999; Cooke, Salas, Cannon-Bowers, & Stout, 2000; Klimoski & Mohammed, 1994) - instead of using a structure that allows for and incorporates evolution and change in team knowledge and team knowledge structure during task cooperation, known as the team situation model (TSM). The TSM is a team cognition structure containing shared task-knowledge and reflecting the team's collective understanding of the specific situation at that moment, an understanding that develops moment-by-moment while the team is engaged in a task (Canon-Bowers, et al., 1999; Cooke, et al., 2000).

As described in the second aim of this dissertation, we shed light on the role that team learning processes play for the TSM (Van den Bossche, Gijselaers, Segers, & Kirschner, 2006; Van den Bossche, Gijselaers, Segers, Woltjer, & Kirschner, 2011). We explored the influence and interplay of the team learning processes of co-construction (the team members share the facts they know and ideas they have and build meaning by refining, further developing, or modifying the original input; Van den Bossche, et al., 2006) and constructive conflict (the negotiation of differences in interpretation between team members by arguments and argumentations; Van den Bossche, et al., 2006) on the TSM and team effectiveness. In line with the third aim of this dissertation, we also studied how evolving similarity in knowledge (TSM) among team members during task execution influences team effectiveness.

As a starting point for this research, we developed a theoretical framework for team learning and team cognition in the OSCT and a measure for its team effectiveness. In the following sections we summarize both after which we outline the main findings of our empirical studies.

1. The conceptual model of this dissertation

The first question we answered in this dissertation is how team learning processes and team cognition structures emerge in the on-scene-command-team (OSCT). In chapter 2, we broadly explored team learning in an emergency management context as a first orientation into the subject. In chapter 3, we developed a context-specific team learning model for the OSCT based on general team learning models. We determined the features of team learning processes and team learning outcomes in terms of team cognition for this specific context. We first identified the specific features of the team un-

der study. Then we determined how team learning outcomes and processes appeared in that specific situation.

The model acknowledges the sequential action and transition phases (Marks, et al., 2001), during each of which the team members use different team learning processes (see Figure 1). Team activity and boundary crossing emerge during the action phases, in which the team members coordinate the own unit at the scene and execute the actions agreed on during the meetings. During transition phases, the team members use sharing information, co-construction of meaning, constructive conflict, reflexivity, and storage and retrieval of information. Transition phases are similar to the team meetings in which the team members develop a team situation model (TSM) of the task, containing knowledge about what is going on and needs to be done at the scene, and a TSM of the team, containing knowledge about emergent states (shared habits and routines, work structure facets, team member acquaintance) and beliefs in the interpersonal context (i.e., psychological safety, cohesion, interdependence, group potency) (Van den Bossche, et al., 2006). The TSM is an evolving team cognition structure that contains shared knowledge in terms of mutual understanding and agreement among team members. These TSMs evolve due to the experiences the team members have at the scene during action phases and the interaction between team members during the team meetings.

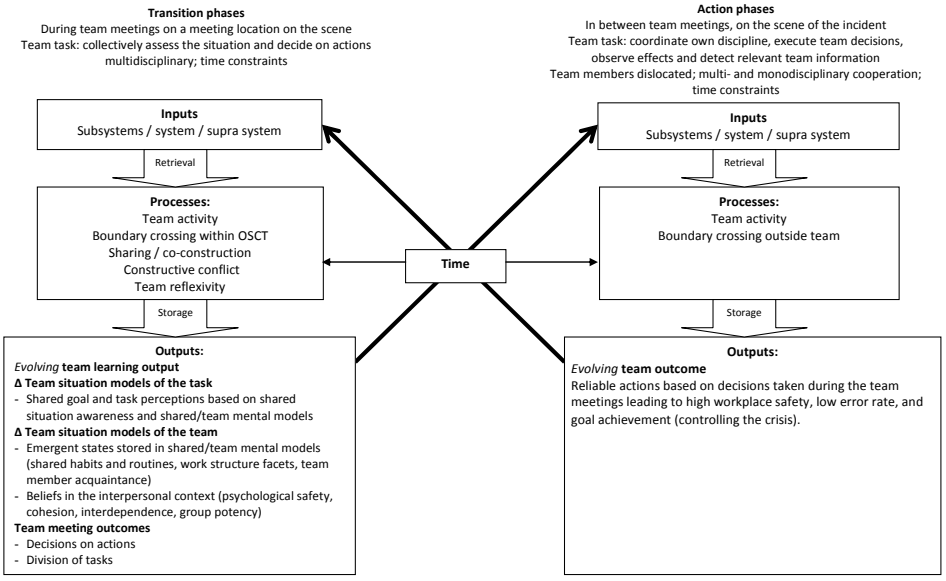
The value of developing a context-specific approach instead of using general team learning models solely is that it acknowledges the influence of team-specific environmental and team features on the team learning processes used. The influence of time (e.g. the level of time pressure) and the developmental stage of a team especially seem to be relevant (Decuyper, Dochy, & Van den Bossche, 2010), considering different team learning processes may be used in different stages of a team's existence and time pressure may influence the appearance of team learning processes as well. By identifying the team learning processes used by a team during different cycles of action and transition phases (Marks, et al., 2001), team learning is understood in a dynamic and context-specific way. As such, the unique character of a team is acknowledged, which opens up the possibility of developing applied research on team learning and team cognition as well as training and evaluation applications. An increase of context-specific team learning research could improve our understanding of the phenomenon, for it can shed light on the team learning features that are similar for any team and the features that relate to specific team types and contexts only.

In summary, *the team learning model for the OSCT indicates that during action and transition phases the OSCT uses team learning processes that collectively contribute to an evolving team situation model of the task and an evolving team situation model of the team (Figure 1).*

2. Development of a team effectiveness scale

To be able to study team learning in the context of emergency management, we developed and validated an ecologically-valid scale for measuring team effectiveness in the setting of the OSCT (chapter 4). In general, team effectiveness is a multidimensional construct (e.g. Cohen & Bailey, 1997; Hackman, 1987; Guzzo & Dickson, 1996; Tannenbaum, Beard, & Salas, 1992). The dimensions performance effectiveness (the quantity and quality of outputs, e.g. efficiency, productivity, response times, quality, customer satisfaction, innovation), attitudinal outcomes (e.g. team satisfaction, commitment, trust in management), and behavioral outcomes (e.g. absenteeism, turnover, safety) hold different values for different team types related to their team values, team activities, and team context (Cohen & Bailey, 1997; Delgado Piña, Romero Martínez, & Gómez Martinez, 2007). Our goal was to identify the relevant dimensions and values for team effectiveness of the OSCT.

Figure 1. A Team Learning Model for the On-Scene Command Team (OSCT)



We explored the opinions of 32 field practitioners about the indicators of OSCT team effectiveness with an open-ended questionnaire. This revealed the need to distinguish between the effectiveness of team meetings and the effectiveness of the response at the scene of the incident. We developed an initial scale for team effectiveness, including 28 items for both aspects of effectiveness, which we tested in a second study with 50 OSCTs participating in an emergency management simulation exercise. The study included 224 team members and 336 external raters. Factor analyses revealed that the

scale had 21 items with a five factor structure. The factors image building and wrapping up the meeting related to the team meeting outcome effectiveness (8 items), and the factors quality of actions, goal achievement, and error rate related to the results of the response (13 items). The scale appeared to be a statistically valid measure, with both convergent and discriminant validity. We also evidenced participant-external rater invariance and proved that aggregation of individual data to be able to look at the results from the team level is justified.

In summary, *the team effectiveness of the OSCT can be measured with a valid context-sensitive scale containing 21 items divided over five factors. The factors 'image building' and 'wrapping up the meeting' measure the effectiveness of the team meeting outcome, and the factors 'quality of actions', 'goal achievement', and 'error rate' measure the effectiveness of the response at the scene.*

3. Relations between team learning processes, the team situation model, and team effectiveness

In chapter 5, we described an empirical study on the relation between the team situation model (TSM: a shared understanding in the OSCT of which emergency management processes to continue or initiate at the scene), team learning processes, and team effectiveness. We measured the TSM during the task immediately after the second team meeting.

First, the study revealed that the team learning processes co-construction and constructive conflict used during the team meeting play a role in the development of the TSM. Both low and high co-construction are beneficial for the TSM at a high level of constructive conflict. This indicates that it is not enough when team members only share what they know; they need to critically question each other's contribution and (collectively) developed ideas. Furthermore, they need to act upon comments. Apparently, the time constraints the OSCT face do not seem to decrease the importance of discussion and negotiation. This finding confirms earlier research in student teams performing a business game (Van den Bossche, et al., 2006, 2011) and thus seems to be applicable to different team types. It also confirms the idea of Houghton and colleagues (2000) that teams need a critical attitude towards input information to avoid negative effects such as "groupthink" (Janis, 1972).

Second, the study revealed that it is beneficial for the quality of the actions at the scene of an incident if the OSCT members develop a TSM of the emergency management processes that the different disciplines will be starting or continuing at the scene after the meeting. The quality of actions refers to the coordination between units, the justification, adequacy, and coordination of actions, and the on-scene safety of professionals and civilians. Apparently, teams that have to deal with time constraints and high task demands operating in non-routine situations indeed need similarity to anticipate

the actions that are needed and to be able to make quick decisions (Comfort, 2007; Lim & Klein, 2006; Stout, Cannon-Bowers, & Salas, 1996). Knowing what others will be doing can simplify the adaptation to novel elements in the situation and to the actions or needs of colleagues at the scene (Uitdewilligen, Waller, & Zijlstra, 2010).

Third, we found that team learning processes do not directly influence team effectiveness and thus the TSM does not mediate the relation between team learning processes and team effectiveness. This finding contradicts earlier studies (i.e., Edmondson, 1999; Van der Vegt & Bunderson, 2005; Van den Bossche, et al. 2006, 2011). These studies all measured overall team learning after task completion. We measured team learning processes during the task execution, more specifically, during the second team meeting instead of after team cooperation has finished. This might explain the different results.

In sum, *low as well as high co-construction is beneficial for the development of the TSM if there is a high level of constructive conflict. Teams that are able to get on the same page concerning what emergency management processes need to be initiated or continued at the scene of the incident (TSM), have a better quality of actions at the scene.*

4. Evolving team cognition

In Chapter 6, we reported on the empirical study in which we investigate how the development of the team situation model (TSM: a shared understanding in the on-scene-command-team (OSCT) of which emergency management processes to continue or initiate at the scene) in the first phase of emergency management contributes to team effectiveness. We made a distinction between action phases, in which the team members were occupied with coordinating the activities at the scene, and transition phases, during which they had team meetings to discuss the situation and decide on what needed to be done. We investigated the evolution of TSM similarity during the first two action and transition phases. In doing so, we effectively studied team cognition as an emergent state instead of a crystallized team property (DeChurch & Mesmer-Magnus, 2010; Wildman, Thayer, Pavlas, Salas, Steward, & Howse, 2012).

First, the results showed that not only the actual similarity of the TSM, but also the change in TSM similarity over time matters for team effectiveness in terms of the quality of actions and goal achievement. This means that it is beneficial to the eventual outcome of the entire emergency management process if an OSCT manages to create more TSM similarity during the first two action and transition phases, while new information becomes available about what is going on at the scene. This similarity enables teams to coordinate and communicate with each other (Marks, Sabella, Burke, & Zaccaro, 2002; Marks, Zaccaro, & Mathieu, 2000) in an increasingly effective way over time

and to interpret changes in the team's functioning situation (Marks, et al., 2000), all of which lead to high team effectiveness at the end.

Second, a stable TSM similarity pattern in a team is detrimental to the team effectiveness compared to an increasing similarity pattern. Stability in TSM similarity may indicate that a team is not capable of processing new information into a collectively shared view on what actions are required at the scene. It may also indicate that the team suffers from the information sampling bias (Stasser & Titus, 1985): team members only share what is already known by all members and not what is unshared (Mesmer-Magnus & DeChurch, 2009). Research has shown that information held by only one person in a team is omitted from discussion (Mesmer-Magnus & DeChurch, 2009; Stasser, Taylor, & Hanna, 1982), unless the team members mutually recognize each other's responsibility for specific domains of information (Stasser, Steward, & Wittenbaum, 1995). These effects worsen if a team also deals with a confirmation bias: team members overemphasize information that confirms the original interpretation and discount information inconsistent with it (Perrin, Barnett, Walrath, & Grossman, 2001).

Based on the findings in Chapter 5 of this dissertation, we assume that teams with a stable pattern might use less constructive conflict, perhaps driven by the two biases. Over time, these cognitive biases prevent teams from incorporating new information and developing TSMs that are more similar, which will in turn result in inadequate decisions, inaccurate judgment, and insufficient adaptation (Burke, Stagl, Salas, Pierce, Kendall, 2006; Nickerson, 1998; Wittenbaum, Hollingshead, & Botero, 2004) and finally lead to a low level of team effectiveness.

The third finding surprisingly revealed that teams with decreasing TSM similarity did not show less team effectiveness than teams with an increasing pattern. This seems to be contradictory to earlier studies that showed the importance of similarity (e.g. DeChurch & Mesmer-Magnus, 2010; Lim & Klein, 2006; Mohammed, Ferzandi, & Hamilton, 2010; Smith-Jentsch, et al., 2005; Resick, Dickson, Mitchelson, Allison, & Clarke, 2010; Van den Bossche, et al., 2006; Waller, Gupta, & Giambatista, 2004; Webber, Chen, Payne, Marsh, & Zaccaro, 2000). So during the early stage of an OSCT's life it is not particularly detrimental if the team members are less in agreement about the required processes at the scene after meeting 2 than they were after meeting 1.

A possible explanation for the value of a decreasing TSM similarity pattern is that teams with such a pattern already have reached a shared understanding of the very basic facts of the overall situation and the most crucial actions to take during the first transition phase (meeting 1). After that, the team members may face increasingly complex situations with constantly changing information. They not only need to share the most relevant and important information, but also activate and utilize their unique discipline-specific knowledge to perform their tasks. Utilizing their unique knowledge may decrease the sharedness of their situation models and result in a decreasing TSM similarity over time, but it may also be necessary for a team in order to achieve high effectiveness in the end. For instance, if the fire department is not aware that the med-

ical assistance unit has started psychosomatic assistance for victims this probably does not reduce the quality of their actions and their goal achievement. So if team members use their own unique knowledge this may decrease the similarity in ideas about what tasks are going to be executed and thus result in distributed situation awareness (Stanton, Stewart, Harris, Houghton, Baber, McMaster, (…), & Green, 2006), but may at the same time increase the eventual quality of the work and goal achievement.

We suppose that a decreasing TSM similarity can only work if a team has a well-functioning transactive memory system, that makes team members aware of who knows what and who needs what information so that team members can rely on one another for specific expertise and are freed of the inefficient process of developing knowledge already available in the team (Lewis, 2003). In doing so, the transitive memory system enhances team effectiveness (Ellis, 2006; Hollingshead, 2000; Lewis, 2003, 2004; Liang, Moreland, & Argote, 1995). A certain degree of cross-understanding (Huber & Lewis, 2010) of each other's mental models, and thus of each other's information needs, will support the dissemination of relevant information.

Methodologically, the study confirms the importance of distinguishing between variances-based models and process-based models (Van de Ven, 2007; Van de Ven & Poole, 2005) in the study of team cognition development over time. The results of our study are illustrative. The inter-team longitudinal approach (i.e. a variance-based model) that focuses on sample-level change patterns (Li & Roe, 2012) showed that TSM change has a positive impact on team effectiveness measured by the quality of actions and goal achievement. This creates the expectation that only an increasing pattern is beneficial, and that a decreasing pattern is worse than a stable pattern. However, the intra-team longitudinal approach (i.e. a process-based model that focuses on sample-level change patterns [Li & Roe, 2012]) revealed that both teams with increasing and decreasing patterns outperform teams with a stable pattern on both the quality of actions and goal achievement.

Hence, findings of our study are in line with Li and Roe's (2012) arguments that results from the inter- and intra-team approach complement each other and confirm Van de Ven and Poole's (2005) suggestion that coordinating the pluralistic insights from variances-based and processes-based models can provide a richer understanding of organizational changes (including changes in teams and individuals) than any variances- or processes-based model provides by itself.

In summary, *the early development of the TSM similarity in OSCTs is important for its team effectiveness (quality of actions and goal achievement). Teams with such an increasing pattern outperform teams with stable TSM similarity. There is no difference in team effectiveness between teams with an increasing or decreasing pattern, however. Using an intra-team approach for studying TSM development complements an inter-team approach.*

5. Limitations and suggestions for further research

In this dissertation we have argued that different team learning processes are used during action and transition phases and we made a start with investigating team learning and team cognition from this dynamic perspective. Doing so, we intended to contribute to general models for team learning (Decuyper, et al., 2010; Edmondson, Dillon, & Roloff, 2007; Jehn & Rupert, 2007; Wilson, Goodman, & Cronin, 2007) that do not acknowledge the context-specific and temporal character of team learning. The results presented in this dissertation show that team learning processes positively influence TSM similarity at the scene during the second team meeting, which is the second transition phase of the on-scene-command-team (OSCT). The results also revealed that this TSM benefits team effectiveness if it evolves during the first phase of the OSCT's life. However, there are several interesting areas for future research, which we will now describe.

5.1 Team cognition structures

In this dissertation we focused on the TSM of the task. Future research should reveal how not only the TSM of the task, but also the TSM of the team plays a role and evolves over time. This also creates an opportunity to unravel the relation between these structures (Wildman, et al., 2012; DeChurch & Mesmer-Magnus, 2010) and their effects on team effectiveness.

While in this dissertation we focused on the level of similarity in knowledge among team members at a certain moment (TSM similarity), future research should also acknowledge the level of accuracy of this shared knowledge and how this relates to TSM similarity and team effectiveness. The TSM accuracy indicates whether the shared understanding is based on the right facts (Mathieu, et al., 2000). The discussion about the value of accuracy right now is merely situated in research studying the team mental model (TMM), which refers to collectively owned long-term task-relevant knowledge that team members bring to a situation (Canon-Bowers, et al., 1999; Cooke, et al., 2000). Although the general expectation is that the positive impact of TMM similarity on team effectiveness is strengthened when the TMM content is also accurate (Mathieu, Heffner, Goodwin, Cannon-Bowers, & Salas, 2005; Mohammed, et al., 2010), research findings are inconsistent. Some studies evidenced the value of TMM accuracy (e.g. Cooke, Kiekel, & Helm, 2001; Edwards, Day, Arthur, & Bell, 2006; Lim & Klein, 2006; Mathieu, et al., 2005), but others did not (Mohammed, et al., 2010; Webber, et al., 2000). We therefore suggest including TSM accuracy as a factor or topic of study in future studies.

5.2 Distributed knowledge

In contradiction to studies that point to the relevance of shared knowledge for team effectiveness (e.g. DeChurch & Mesmer-Magnus, 2010; Kozlowski & Ilgen, 2006), Stanton and colleagues (2006) argue that multidisciplinary teams that have to act at the scene of an incident and have a decision-making task, benefit from having distributed situation awareness, which they define as the activated knowledge for a specific task within a system. It is this system, and not each individual, that holds all relevant knowledge. Individuals possess different parts of this knowledge, which might or might not overlap and which they need for their own task. Furthermore, they have an awareness of who is likely to hold which specific information and how valuable this information is for who else, as well as where to offer information when necessary. Functional distributed situation awareness is thus based on effective dissemination of information (Stanton, et al., 2006). The same principle is found in the theory about cross-understanding (Huber & Lewis, 2010), which states that team members have an awareness of the mental models of the other team members and thus are aware of what the team collectively knows and with whom to exchange information.

If a team is able to encode, store, and retrieve information on the group-level, this information is then collectively owned and the team then has a transactive memory system (Lewis, 2003). This system consists of three parts: specialization (members having specialized knowledge), credibility (team members trust and rely on each other's expertise), and coordination (team members integrate the knowledge in a coordinated fashion) (Lewis, 2003; Liang, et al., 1995; Moreland & Myakovsky, 2000). The consequence of having a well-functioning transactive memory system is that members can rely on one another for specific expertise and are freed of the inefficient process of developing knowledge already available in the team (Lewis, 2003). Such a system enhances team performance (Ellis, 2006; Hollingshead, 2000; Kamphuis, Gaillard, & Vogelaar, 2010; Kozlowski & Ilgen, 2006; Lewis, 2003, 2004; Liang, et al., 1995; Moreland & Myakovsky, 2000; Prichard & Ashleigh, 2007; Wegner, 1986; Zhang, Han, Hempel, & Tjosvold, 2007).

Future research that takes TSM similarity, TSM accuracy, distributed knowledge, and the strength of the transactive memory system during the response on an emergency incident into account, could clarify the balance that is needed among team members between shared and unshared knowledge and how this balance eventually affects team effectiveness (Wildman, et al., 2012; DeChurch & Mesmer-Magnus, 2010).

5.3 Evolving team cognition and team learning

In this dissertation, we studied the evolution of team cognition reflecting task knowledge during the early stage of the OSCT's existence. This does not predict how team cognition will develop during further stages or whether TSM similarity remains equally important for team effectiveness over time. Besides the evolution of team cog-

nition, we need further research into the role team learning processes play during action and transition phases at different stages in the team's life. The question is whether our finding that low and high co-construction benefit the development of TSM similarity under the condition of high constructive conflict is generalizable to all meetings over time during one incident. For instance, it could be that the use of constructive conflict will appear less in first meetings and more as the team grows older and team members get more familiar with each other. Former research (Gruenfeld, Mannix, Williams, & Neale, 1996) has shown that in teams where team members are familiar with each other, the members are more comfortable with disagreeing with each other than in teams where they are unfamiliar with each other. The higher the acquaintance among members, the higher the comfort with expressing disagreement. The question is how that influences the development of TSM similarity and accuracy. Further research might find an explanation for our finding that a stable TSM similarity pattern is unfavorable to team effectiveness: these teams may be unfamiliar and / or use less constructive conflict.

These research ambitions require a temporal research design (Li & Roe, 2012) with multiple measures during task performance that study the appearance of team cognition and the use of team learning processes during the OSCT's existence. Such research would contribute to a better understanding of the extent to which a team needs similarity in the distribution of knowledge among team members over time and which behavior is effective at different stages in the team's life.

5.4 Team member familiarity and team identification

We suggest future research investigates the influence of team member familiarity and team identification on the OSCT processes and outcomes. Research has shown that command-and-control teams with experience in working together show better performance than teams with less mutual experience (Cooke, Gorman, Duran, & Taylor, 2007). We also know that teams with all unfamiliar members have a better team performance if information is fully shared, while teams with familiar members have a better result when some of the critical information remained unshared (Gruenfeld, et al., 1996). This makes familiarity an important antecedent of team learning processes in the OSCT.

If team members have met before in another team composition managing an emergency, they are more familiar with each other and the task and will know better what to expect from each other. Teams with a higher familiarity also have had more time to develop an accurate transactive memory system (Lewis, 2003, 2004). Moreover, we assume that teams with higher familiarity are better able to share relevant information for co-construction, even when this information is unique and held by a single member (Gruenfeld, et al., 1996). As already argued, the familiarity level may also positively influence the extent to which a team uses constructive conflict (Gruen-

feld, et al., 1996), which lowers the chance the team develops groupthink or a confirmation bias. Therefore, we propose highly familiar OSCTs will develop more accurate team cognition structures than teams with a lower familiarity.

The aforementioned effect of familiarity on the team learning processes of co-construction of meaning and constructive conflict may relate to team identification. Van der Vegt and Bunderson (2005) have shown that team identification ("the emotional significance that members of a given group attach to their membership in that group", Van der Vegt & Bunderson, 2005, p. 533) mediates between expertise diversity on the one hand and team learning and team performance on the other. Apparently team identification supports teams in making use of each other's expertise. Since expertise diversity is present in the OSCT, we assume that the level of team identification influences the level to which the team succeeds in making use of this diversity through sharing information, co-constructing meaning, and having constructive conflicts. If a team has low familiarity, this may be compensated by a high team identification level, caused by the shared goal of getting control of the emergency situation.

5.5 Measurement issues

Unraveling which information should be shared and which not, both content-wise and process-wise, over time, and how this dissemination of information should be executed, requires a sophisticated research design that uses content analyses and objective behavior scores. However, the reality of the OSCT with its time constraints and work pressure forces us to develop methods that generate valuable information, but do not hinder task execution. We have to fall back on videotaping, questionnaires with self-reports and external ratings, and interviews with teams and team members after team cooperation has already finished. It would be worth-wile to study teams on scene performing during real incidents, as long as this does not hinder emergency management. Research with real life teams would extend team cognition research (DeChurch & Mesmer-Magnus, 2010) and team learning research (Kozlowski & Ilgen, 2006).

Supportive for such research will be the use of the team effectiveness scale we developed. However, we suggest conducting a second validation study first, preferably in an applied setting of a real incident, to confirm the convergent and discriminant validity. Moreover, we suggest developing a team learning processes measurement in addition to the self-report scale we have used in our studies. If teams could be videotaped and their behavior coded as co-construction or constructive conflict, this will offer more objective scores. We could calculate the frequency of certain behavior, as well as the content of co-construction and constructive conflict at different stages. In addition, this type of research should be conducted in emergency management command-and-control teams as well as in different team types with different characteristics and different tasks. That way, we can discover the universal characteristics of team learning as well as unique team-specific features.

We suggest investigating the accuracy of the team cognition structures directly and not via self-reports. We need to check if the emergency management processes that team members indicated as relevant at a certain moment are indeed the best ones to pick at that time, by comparing it with an expert model as a referent model (e.g. Edwards, et al., 2006; Mohammed, et al., 2010).

5.6 Generalizability of the findings

In this dissertation we intentionally focused on one team type. We studied the on-scene-command-team (OSCT), because it was our explicit aim to increase our understanding of intra-crisis learning (Moynihan, 2009) and study team learning from a contextual perspective. However, our findings can be used for teams with similar characteristics: a multidisciplinary ad hoc composition, a coordinating task in the own disciplinary unit for each team member, frequent team meetings alternated with actions in and of the own unit, time and work pressure, high risk, and non-routine tasks. Examples of such teams are other emergency management teams with different compositions than the OSCT, emergency management teams with other command-and-control tasks than the OSCT, for instance the Operational Team that is responsible for the effects of the incident on the area surrounding the scene (see Chapter 2), hospital command-and-control teams coordinating the response to an incident with an exceptional number of victims, military command-and-control teams, or command-and-control teams coordinating a large event such as a festival. Future research should reveal if the model, or specific components of the model, can be generalized to such teams. Moreover, if we develop and validate context-specific team learning models for teams with different features, we will be able to discover what team learning processes and outcomes are important for teams in general, and how teams differ in this sense.

6. Practical implications

Emergency management teams are heavily responsible for civilians caught in severe circumstances, for property, and for the environment. Understanding what supports them in performing well is not only valuable for the civilians involved, but especially for the team members that have chosen to shoulder this responsibility and the risks involved. The results of this dissertation can be used for evaluating how an OSCT performed during a real incident, and for developing training activities for these teams. This can benefit the emergency service worldwide.

For the evaluation of emergency management incidents the team effectiveness measurement scale developed in Chapter 4 can be used to better understand what happened and to learn from mistakes. It provides information about the team meeting effectiveness and the effectiveness of the eventual results of the response at the scene.

If both team members and external evaluators fill it in after the incident, the results combine a number of points of view, which can enhance the quality of the evaluation and foster a discussion about the level of team effectiveness and its causes. This discussion that can have relevant and important learning effects. Filling in the score form and comparing the scores among team members and evaluators is a starting point for investigating the adequacy of the process, cooperation, and decisions taken during team meetings and in between. Additional information that helps with a reconstruction and overview of, for instance, the time frame, the decisions made, their argumentations, and the actions taken is required for understanding the level of team effectiveness. Possible sources are situation reports and interviews with team members and cooperating partners at the scene.

This dissertation reveals the importance of using the team learning processes of co-construction and constructive conflict during OSCT meetings. These processes should be integrated in the team meeting protocol so that members are invited to be critical towards shared information and ideas. The team leader can play a crucial role in inviting and encouraging critical questioning. He or she can start the first team meeting with an explicit invitation to speak up and respect each other's contribution. Accordingly, he should acknowledge each constructive attempt to do so whether it appears to be a value remark or not. Moreover, the team leader can invite team members to add to the shared facts and ideas (e.g. 'What other facts do we know concerning this issue', 'How can we elaborate on this suggestion?') but also question what is shared (e.g. 'Did the others observe the same?', 'Is there any reason why we should not embrace this solution?'). In some cases, he or she could play the role of the so-called 'advocate of the devil'. The team leader needs to monitor whether the team members tend to continuously affirm, approve and agree with each other without being critical, and needs to support a critical attitude to avoid a confirmation bias. This way, the team leader facilitates the team in not being scared off by an appearing disagreement, but embracing the differences and constructively explore them to come to an agreement.

Concerning the OSCT meeting structure, we suggest to end each meeting with a summary of the emergency management processes that will be continued or started after the meeting. This small intervention will support team members in having a shared understanding of which emergency management processes are or will be running at the scene which is beneficial for the eventual quality of the actions at the scene.

This dissertation offers some directions for the training of emergency management command-and-control teams, such as the OSCT, as well. The instruments we used in this dissertation for measuring team effectiveness, the team learning processes, and the team situation model can be of use for simulation exercises in which the OSCT is able to learn from practicing emergency management tasks in a safe setting. The team effectiveness scale can mark the results of the OSCT actions as more or less desired. The measurement of team learning and the team situation model (TSM) could be beneficial for the envisioning of the cooperation process in the OSCT. Together these

measures stimulate the dialogue about how the team processes lead to a more or less shared understanding of required emergency management processes at the scene of the simulated setting and about the effect of both on the eventual effectiveness. To this end, the team effectiveness scale can be filled in after finishing the simulation exercise. Filling in the team learning scale, as well as ticking off the relevant emergency management processes from a provided list of options can be planned after each team meeting. This way the evaluation of the simulation can focus on particular points in time.

Because our studies revealed the value of team learning processes and especially of constructive conflict, OSCT training activities should enable OSCT members to practice such behavior and experience its value. This requires that OSCT members get feedback on the behaviors they used and the interpersonal processes they led to during meetings. The measurement instrument of team learning behavior can help with this feedback. Moreover, training activities need to enable the OSCT members to increase their awareness of the emergency management processes that each OSCT member considers important from his or her discipline-specific view. To this end, the OSCT could be assigned to close off each team meeting with a summary of required emergency management processes. Cross-training could also be an option, in which team members participate in a training or simulation in the role of an OSCT colleague to experience his or her point of view during emergency incident management.

7. Conclusion

This dissertation extends the research on both team cognition and team learning by studying emergency management command-and-control teams and focusing on the team situation model (TSM), its influence on team effectiveness, and the role of team learning processes. Furthermore, we contribute to this field of research by indicating how TSM patterns, evolving over time, affect team effectiveness. We hope our findings fuel researchers to further develop this field of team research as well as emergency management command-and control teams and their trainers to optimize the response during emergency situations.