Organizing distributed knowledge for collaborative action: Structure, functioning, and emergence of organizational transactive memory systems

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5 CONCLUDING REFLECTIONS

5.1 Setup of this Chapter

This concluding chapter is organized as follows. First, the answers to the three research questions are being summarized, followed by an explanation of how these answers contribute to the two research objectives that have been formulated in Chapter 1. Third, the implications for TMS theory are being discussed followed by implications for a few related theories. Fifth, the implications for practice are being treated, i.e. in terms of implications for system design and system governance. In the sixth section the limitations of the conducted studies are being discussed, followed in the final section by suggestions for future organizational TMS research.

5.2 Answers to the Research Questions

5.2.1 Research question 1

The first research question has been formulated as follows: how can knowledge transfer among (different types of) knowledge resources in an organizational TMS be strengthened to support temporary and geographically distributed collaborations? Knowledge management literature was used to formally describe three ideal types of knowledge resources that play a role in TMS at organization level, i.e. personalized, encoded, and embedded knowledge resources. Based on conceptual work and field experiments, three types of interventions have been identified that can be used to strengthen knowledge transfer in organizational TMS.

First, knowledge transfer may be strengthened by increasing potential transactivity among knowledge resources. For example, in addition to traditional face to face communication, alternative communication channels may be created. Moreover, opportunities for automated matching and alerting may be increased by enabling the linkage between encoded knowledge resources, such as distributed sensors, registers, and knowledge rules.
Second, tasks may be reassigned to other knowledge resource types. For example, where people are well equipped to interactively assess an idiosyncratic situation, automated routines are better equipped to systematically observe intensive traffic flows on e.g. highways.

Third, knowledge transfer in organizational TMS may be strengthened by organizing differently. An example from the AR is the setup of a virtual team in order to provide local officers with distant expert support. Likewise, sensor networks were being used to increase the sentience of the virtual team, e.g. by making available geographically distributed observations that are related in time and space, and which may be used to initiate local action.

5.2.2 Research question 2

The second research question has been formulated as follows: how are different types of knowledge resources related to TMS, which develops for supporting temporary collaborative action in a geographically distributed setting? Because TMS are cognitive systems people develop to divide responsibilities for interdependent tasks (Ren and Argote 2011), insights were being used from organizational routines theory (cf. Pentland and Feldman 2003; 2008). Indeed, TMS theory and organizational routines theory explain different aspects of collaborative work. Where the first elicits the distribution of expertise in a group, including the processes of specialization and integration, the second is primarily focused on the task. Both theories recognize that knowledge resources other than people do play a role. Where the function of different types of knowledge resources in organizational routines is clearly described, however, in TMS theory the function of knowledge resources other than people is still in debate. Oshri et al. (2008), for example, argue that codified directories (i.e. explicit knowledge, shared through e.g. databases or documents) and personalized directories (i.e. tacit knowledge, shared through personal interaction) should be viewed as complementary. Others suggest that knowledge resources other than people may substitute (parts of) TMS, but only if they can emulate and facilitate transactive processes (Lewis and Herndon 2011).
In answer to calls for research to study what the role and function is of IT (e.g. Choi et al. 2010) and other types knowledge resources in TMS (e.g. Yuan et al. 2011), in this dissertation I suggest to describe the structure and functioning of TMS in the same way as the structure and functioning of organizational routines theory is being described (Pentland and Feldman 2003; 2008) (see Figure 5.1).

![Figure 5.1: TMS as generative system](adapted from: Pentland and Feldman 2008: 241)

Consequently, TMS consist of ostensive and performative aspects which are (possibly, but not necessarily) influenced and represented by artifacts. These three elements are explained next.

First, the ostensive aspects of TMS constitute the collection of shared mental representations of how work is being divided and what the capabilities are of the participating actors. As discussed in Chapter 1, this meta-knowledge includes at least the labels and locations of the involved knowledge resources (Wegner 1986). It further may include meta-knowledge of allocation, updating, and retrieval coordination (Brandon and Hollingshead 2004), emergent behavioral knowledge (Moreland and Myaskovsky 2000; Moreland et al. 1996), soft knowledge, such as belief structures, judgment, intuition (Anand et al. 1998), capability and motivation (Majchrzak et al. 2007), and affect (Huang 2009). Moreover, the shared mental representations of organizational rules that serve as resource for information storage and retrieval (cf. Kieser and Koch 2008)
form ostensive aspects of TMS and may include the shared mental representations of routines or e.g. hierarchical organizational structures (cf. Chapter 4).

Second, like in organizational routines (cf. Pentland and Feldman 2008), the ostensive aspects enable and constrain the actual functioning of a TMS, i.e. the performative aspects of the TMS, which in turn create and recreate the ostensive aspects of the TMS. Thus, the ostensive and performative aspects of TMS are mutually constitutive and form a generative system.

Third, like in organizational routines (cf. Pentland and Feldman 2008), the ostensive and performative aspects may be represented by artifacts (Figure 5.1, downward arrows) or influenced by them (Figure 5.1, upward arrows), and hence, are not part of the TMS.

Besides these findings, analysis of the case material suggests that multiple TMS may be interrelated in two ways. First, a special case of artifacts are so called 'dead TMS', which are fully automated TMS (or subsystems thereof) which are not capable of learning or improvisation (cf. Pentland and Feldman 2008). Second, analysis of the TMS that developed in support of Operation Vigilance showed that actually two TMS had developed, i.e. one in support of the action planning phase, and one in support of the action phase. Moreover, further analysis revealed that five types of overlap could be identified, i.e. overlap in actors, artifacts, relationships among these, and type and content of informational interactions.

5.2.3 Research question 3

The third research question has been formulated as follows: how can functionally structured organizations develop their ability to engage in networked operations, in addition to their functional mode of organizing?

To answer this question the TMS of three collaborating teams have been analyzed. To this end two extensions to TMS theory have been made, i.e. concerning the nature of TMS building blocks, and the qualification of actor agency (i.e. strategic, tactical, and operational).
Before turning to the answer to the third research question, these two additions are explained.

**Concerning the nature of TMS building blocks**

Current TMS literature describe the building blocks of TMS as combinations of Task-Expertise-People (TEP) (Brandon and Hollingshead 2004; Yuan et al. 2007). To cater for the dynamic contexts in which many tasks are being executed, however, the concept of TEP-combinations has to be extended. This concerns two additions. First, in the analysis of the observation team (cf. Section 4.5.3) it was observed that while working on a task, TEP-combinations may dynamically be altered. Hence, in addition to TEP-combinations, its State should be taken into consideration. Second, external conditions may influence the TEP-combinations that are made. As Whiteman and Cooper (2011) analyzed, the environment may demand special sense making skills. This finding is confirmed by the empirical study of Operation Frisau (Chapter 4). In that operation, people working on the ground were not aware of the restrictions of the helicopter induced by the vicinity of a major airport. One of the reasons the operation failed was that context was not considered as factor when forming the TEP-combinations needed to switch from a stealth observation mission to a hot pursuit. Based on this observation, and supported by the work of Whiteman and Cooper (2011), I propose to extend TEP-combinations to Task-Context-Expertise-People combinations (TCEP-combinations) as building blocks of TMS.

**Qualifying actor agency in TMS**

Resources contribute to organized action through their capacity to act, i.e. their agency. Following Mantere (2008) and others (Mintzberg 1980; Simon 1962), a distinction can be made between strategic, tactical, and operational levels of agency, each representing functionally different capabilities. Strategic level agency concerns third order (or meta) governance (Sorensen and Torfing 2009). It is focused on defining the 'rules of the game' (in short: governing principles) in two ways. First, workers negotiate, influence, or adopt shared norms, values, and
principles (cf. Kooiman and Jentoft 2009; Oliver and Holzinger 2008). And second, they develop shared intent and ambition in the sense of strategically positioning the system in its environment (Mantere 2008; Volberda and Lewin 2003). Tactical level agency is associated with second order (or meso) governance. As such it is focused on establishing, shaping and deploying organizational structures and routines to facilitate operational level action (Bigley and Roberts 2001; Burgelman 1996; Rouleau 2005). Operational level agency refers to first-order (of micro) governance (Kooiman 2008), i.e. the primary value creation processes that yield benefits for the system's stakeholders (Mintzberg 1979; Porter-Liebeskind 1996; Sirmon et al. 2007). In less abstract terms: engaging in day-to-day problem solving and the creation of new opportunities.

Thus, rather than associating strategic, tactical, and operational levels of agency with the vertical division of work in hierarchical organizations, levels of agency are being used to refer to functional aspects of work. That is, at each level in the organization people may engage in activities that are strategic (e.g. establishing principles), tactical (e.g. establishing routines or structures), or operational in nature (e.g. carrying out value-adding or problem-solving tasks), the latter being the dominant perspective in extant TMS research. Because each level of agency has its own unique function, they are reflected in both the ostensive and performative aspects of the TMS, as well as in the artifacts used to represent or influence the TMS. Moreover, with respect to the multilevel nature of TMS (cf. Kozlowski and Klein 2000), levels of agency form an additional perspective, rather than an alternative perspective to social aggregate perspectives of multilevel TMS (e.g. individual, group, organization).

Answer to the third research question

The answer to the research question how functionally structured organizations can develop their ability to engage in networked operations in addition to their functional mode of organizing, consists of two parts, i.e. the structure of organizational TMS, and the learning processes that interlink the components of organizational TMS.
The structure of organizational TMS is shown in Figure 5.2. As illustrated in Figure 5.2, in addition to TMS in support of functionally specialized organizational units (functional enactment), and TMS in support of temporary collaborative networks (networked enactment), two types of TMS develop to enable cross-unit collaboration, in addition to their routine (functional) mode of enactment, i.e. a differentiated and an integrated TMS for hybrid enactment.

![Figure 5.2: The structure of organizational TMS](image)

The differentiated TMS for hybrid enactment is being developed by representatives of organizational units. In Operation Frisau these representatives were managers of the collaborating departments, but in other cases they may include less formal groups such as communities of practice (cf. Jarvenpaa and Majchrzak 2008; Hargadon 2002). The differentiated TMS for hybrid enactment is prerequisite for initiating collaborative action (networked enactment) in which distributed capabilities of functionally specialized organizational units are being integrated (cf. Jansen et al. 2009). The integrated TMS for hybrid enactment serves as a common knowledge-base to enable cross-knowledge domain understanding and coordination (cf. Cramton 2001)
and thus moderates the success of functional units to engage in temporary collaborations. In large organizations, consisting of e.g. divisions and departments, I hypothesize that multiple differentiated TMS for hybrid enactment may be found, e.g. dominated by hierarchical levels or disciplines. Within the police, for example, law enforcement departments and criminal investigations departments do work together, but more often they work together with other departments within their own domain (i.e. public order and emergency response, law enforcement, or criminal investigations). It may be presumed they develop a broader or more fine-grained common knowledge-base with those partners with whom they collaborate more frequently. Likewise, multiple integrated TMS for hybrid enactment may be found for collections of groups with more or less frequent collaboration patterns. These TMS, which may be functionally nested, are indicated by the white-shaded boxes behind the four types of TMS (see Figure 5.2).

The learning processes that interlink the components of organizational TMS are represented by the arrows in Figure 5.2. The learning effects can be either direct or moderating and together form a complex organizational learning 'cycle'. Starting from the differentiated TMS for hybrid enactment, opportunities for combining capabilities are identified at management level (cf. Jansen et al. 2009), or any other group in which representatives of divers organizational units convene for current or future collaboration purposes. Thus, this differentiated TMS for hybrid enactment has a direct effect (i.e. initiating) on networked enactment. The temporary networked collaboration is influenced by direct effects stemming from the TMS that develop in support of the respective participating organizational units. These effects can both be complementary and conflicting. In case of the first, combinative capabilities are being developed. In case of the second, combinative capabilities are frustrated by conflicting knowledge patterns, which may originate from, and affect strategic, tactical, or operational levels of agency. During networked enactment lessons may be learned at any of the three levels of agency and used to strengthen the integrated TMS for hybrid enactment. In the second AR, these lessons were drawn by
organizing observants, shared debriefings, and shared reflection sessions. Both integrated and differentiated TMS for hybrid enactment moderate the relation between organizational units and the temporary collaborative actions in which they engage. These moderating effects may originate from and affect strategic, tactical, and operational levels of agency.

Of particular value for hybrid enactment and organizational learning are boundary objects, which are defined as artifacts that have meaning across practices and as such have the potential to improve coordination and synthesis across heterogeneous disciplines (Bechky 2003; Carlile 2004). Within the context of hybrid enactment the boundary objects that influence or represent aspects of the integrated TMS for hybrid enactment are likely the most important for hybrid enactment as they not only have a function across heterogeneous disciplines within a functional organizational unit, but across functional organizational units as well.

5.3 Research Results in Relation to Research Objectives

The theoretic objective of this research was to:
1) to develop organizational TMS theory as a lens to study how distributed knowledge resources may be involved in collaborations, which are temporary and geographically distributed, to head tasks that none of the participants can head (as easily) on its own, and
2) to identify which features of organizational TMS contribute to the robustness and resilience of these collaborations.

In Table 5.1, which is explained below, an overview is given of the contributions of the three empirical studies to the two research objectives.

The first study contributed to the first research objective (develop organizational TMS theory as a lens to study how distributed knowledge resources may be involved in collaborations, which are temporary and geographically distributed, to head tasks that none of the participants can head -as easily- on its own) by introducing the distinction of three knowledge resource ideal types that can be identified at organization level.
<table>
<thead>
<tr>
<th>Study</th>
<th>Research Objective 1</th>
<th>Research Objective 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inclusion of three knowledge resource ideal types.</td>
<td>Increasing potential transactivity; Transforming knowledge resource types; Organizing differently.</td>
</tr>
<tr>
<td>2</td>
<td>Formal inclusion of different knowledge resource types in TMS theory (Fig. 5.1); Understanding overlap of TMS in terms of actors, artifacts, relationships, and type and content of informational transactions.</td>
<td>Strengthening ostensive aspects of organizational TMS; Use of artifacts to represent or influence the ostensive or performative aspects of organizational TMS; Locking-in (aspects of) critical TMS.</td>
</tr>
<tr>
<td>3</td>
<td>Subsystems of organizational TMS (Fig. 5.2); Distinguishing between levels of agency; Inclusion of Context as element in TMS building blocks, and State as dynamic characteristic of overall building blocks.</td>
<td>Strengthening differentiated TMS for hybrid enactment in order to find alternative collaborative solutions; Strengthening integrated TMS for hybrid enactment in order to increase mutual understanding and coordination; Organizational learning processes (direct and moderating effects among organizational TMS-subsystems); Identifying complementary and conflicting direct effects between TMS for functional enactment and TMS for networked enactment; Identification of exclusive links; Investing in affective-based trust; Increasing awareness of effects of stress.</td>
</tr>
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**Table 5.1: Contributions of empirical studies to research objectives**

This extension to TMS theory yielded three insights that contribute to the second research objective of this dissertation (identify which features of
organizational TMS contribute to the robustness and resilience of these collaborations), i.e. increasing potential transactivity; transforming knowledge resource types; and introducing alternative modes of organizing.

The second study contributed to the first research objective by describing the formal role of different knowledge resource types in TMS (cf. Fig 5.1), and by identifying overlap of TMS in terms of actors, artifacts, relationships, and type and content of informational transactions. These extensions to TMS theory yielded three insights that contribute to the second research objective of this dissertation, i.e. organizational TMS may be strengthened through investing in the ostensive aspects of organizational TMS; by using artifacts to represent or influence the ostensive or performative aspects of organizational TMS; and by locking-in (aspects of) critical TMS.

The third study contributed to the first research objective by identifying four subsystems of organizational TMS (cf. Fig. 5.2), by distinguishing between distinct contributions per level of agency, and by the inclusion of Context as an element in TMS building blocks and State as dynamic characteristic of these building blocks. These extensions to TMS theory yielded four insights that contribute to the second research objective of this dissertation, i.e. strengthening differentiated TMS for hybrid enactment in order to find alternative collaborative solutions; strengthening integrated TMS for hybrid enactment in order to increase mutual understanding and coordination; organizational learning processes (direct and moderating effects among organizational TMS-subsystems); and the identifying complementary and conflicting direct effects between TMS for functional enactment and TMS for networked enactment.

In addition to these findings, the third study yielded three findings that overarch its research question but which nonetheless contribute to the second research objective, i.e. the identification of exclusive links (which should be avoided because they threaten the robustness of the team); the effect of (a lack of) affective-based trust (which should be avoided because it hampers explicit communication and fact checking); and the identification of two effects induced by stress (i.e. network horizon
regression effect and the level of agency regression effect). The effects related to trust and stress are shortly elaborated upon next.

*On the effects of trust in TMS development*

In TMS trust is usually studied in the form of cognitive-based trust (e.g. Kanawattanachai and Yoo 2007). This form of trust is also known as task credibility (Moreland and Myaskovsky 2000) and is being described in terms of source credibility and trustworthiness (Nevo and Wand 2005). The analysis of Operation Frisau revealed that next to cognitive-based trust, affective-based trust needs to be taken into consideration. The latter may be defined as the “expectations, assumptions, or beliefs about the likelihood that another’s future actions will be beneficial, favorable, or at least not detrimental to one’s interests” (Robinson 1996: 576). Although in Operation Frisau cognitive-based trust was high, affective-based trust was low. This was caused by unresolved conflicting principles with respect to information sharing.

*On the effects of stress on TMS development*

As has been found in other studies (e.g. Ellis 2006; Ellis and Pearsall 2011; Pearsall et al. 2009; Rau 2005), the analysis of Operation Frisau illustrates that stress has an important moderating effect on TMS development. Where Ellis (2006) found that stress reduces TMS related communication, in the Frisau case study two additional effects related to stress were found. First, it is well known that people under stress tend to redraw to their comfort zone, i.e. fall back on older learned routines (*cf.* Staw et al. 1981). In Operation Frisau this resulted in a 'network horizon regression effect', defined as a reduced awareness and perception of who is part of the team (*cf.* van Liere 2007). Second, an 'agency regression effect' was found, which was defined as the tendency of people under stress to decent one level of agency: strategic leaders start to concern themselves with tactics, and tactical leaders become operationally involved. The first effect may be corrected if tactical level agency remains organized, i.e. the capacity to create and recreate the structures and routines needed by the group. The empirical study presented in Chapter 4
suggests that if tactical level agency is not effective, the network disintegrates.

5.4 Implications for TMS Theory

The theoretical contributions made have several implications for theory, i.e. for group TMS, organizational TMS, organizational TMS development, and the development of organizational TMS assessment methods. In the following paragraphs each of these research themes is being addressed.

5.4.1 Implications for group TMS research

Based on the theoretical contributions described in section 5.2 and 5.3, in this paragraph a summary is given of aspects that should be accounted for in future (single) group TMS research.

TMS development may take place at strategic, tactical, and operational level. Although this notion is highly relevant when cross-team TMS are being developed, in which complementary and conflicting principles, or structures of routines may have to be unified, it is also relevant in TMS that develop in single groups. That is, it is important in the development phase of group TMS (cf. Littlepage et al. 2008), when the group may have to form, for example, its norms and values. It may also be important during the utilization phase (cf. Littlepage et al. 2008), when disruptions may require new principles, or when actors routinely switch operational task responsibilities among themselves. Hence, when a group TMS is being studied, its development and utilization should be qualified in terms of levels of agency.

In additional to Task-Expertise-People-combinations, Context should be addressed. Moreover, researchers should be aware that TCEP-combinations may be stable at e.g. strategic and tactical level, while they are dynamic at operational level, like was the case with the observation teams in the Frisau case (cf. Chapter 4). Hence, in case TCEP-combinations are dynamic during the execution of a task, TCEP-state should be addressed, too.
When artificial repositories for information storage and retrieval are being studied, their relation to TMS should be expressed in terms of influencing the ostensive aspects of TMS (see e.g. the study of Moreland and Myaskovsky 2000) or the performative aspects of TMS (e.g. Faraj and Sproull 2000); or in terms of representing the ostensive aspects of TMS (e.g. Nevo and Wand 2005), or the performative aspects of TMS (e.g. iFunnel technology used during Operation Vigilance).

Finally, TMS researchers should be aware of the effects on TMS of stress (i.e. network horizon regression and level of agency regression) and trust. With respect to the latter, in addition to cognitive-based trust, researchers should be aware of the influence of affective-based trust.

5.4.2 Implications for organizational TMS research

Current views on organizational TMS hold that they resemble the (hierarchical) structure of the organization (e.g. Anand et al. 1998; Nevo and Wand 2005; Wegner 1986), or that they are composed of a collection of overlapping ego-centered networks complemented with facilitative ICT (e.g. Jackson and Klobas 2008; Jarvenpaa and Majchrzak 2008). Using the perspective of organizational TMS as presented in Figure 5.3 these studies can be related to one another.

First, the work of Anand et al. (1998) and Nevo and Wand (2005) covers the collection of (functionally specialized) organizational units and the differentiated TMS for hybrid enactment. In their work, however, the latter is depicted as a higher hierarchical level in support of TMS at lower hierarchical levels and does not explain the function of these TMS at higher management level in relation to networked enactment. Second, the work of Jackson and Klobas (2008) emphasizes the ability of individuals in organizations to establish cross-unit contacts. As such their work concentrates on what I conceptualize as differentiated TMS for hybrid enactment, although they remain silent about the structural nature of these collaborations. Finally, the work of Jarvenpaa and Majchrzak (2008), which is focused on temporary (inter-) organizational networks, concentrates on what I conceptualize as temporary TMS for networked enactment.
Thus, as depicted in Figure 5.3, existing TMS studies address different aspects of TMS in organizations that engage in temporary collaborations, but nonetheless, are related. It also shows that important areas of organizational TMS are not being covered, including the integrated TMS for hybrid enactment and the organizational learning processes among the TMS-subsystems in organizations. Hence, future TMS research at (inter) organization level should explicate which subsystems are being studied and how these are affected by other TMS through moderating and direct effects.

5.4.3 Organizational TMS development

The notion that TMS cannot be designed, but can be designed for (cf. Wenger 1998) exceeds the development of semi-structures to help understand how knowledge is disseminated, owned, and discussed in ego-centered networks (cf. Jarvenpaa and Majchrzak 2008). Although TMS are emergent, the interventions discussed in this dissertation illustrate Wegner's early notion that ‘the structuring of an organization is clearly an exercise in structuring transactive memory’ (1986: 204), and are
supported by the work of Gittell and Weiss (2004), who indicate that organizational design may be used to shape networks. Examples in this dissertation include organizing for transactivity among knowledge resources of the same type, transforming knowledge from one type of knowledge resource to another, and locking-in critical routines. Such organizational TMS development efforts should be aimed at providing for stable structures to enable future temporary and geographically distributed collaborations (cf. Moreland and Argote 2003; Powell et al. 2004) and, hence, are aimed at strategic (e.g. guiding principles) and tactical level (e.g. organizational structures and routines).

5.4.4 Organizational TMS assessment

In the TMS literature several methods have been developed to assess the state of TMS development (e.g. Kanawattanachai and Yoo 2007; Lewis 2003; Littlepage et al. 2008). All of them are defined at the team level of analysis (including dyads and triads). While all distinguish between a development phase and a utilization phase, they also acknowledge that the two are mutually constitutive, i.e. TMS develop through utilization while at the same time its utilization is limited by its state of development. With respect to measuring the TMS state of development, Brandon and Hollingshead (2004) hold that in its optimal state of development (called Convergence) a TMS reflects high levels of accuracy (degree to which perceptions about group members are accurate), sharedness (degree to which perceptions of group members are shared by all group members), and validity (degree to which group members actually make use of group members’ expertise). To be able to assess TMS at organization level, at least three issues have to be addressed.

First, while existing team-TMS assessment methods predominantly focus on operational level constructs, i.e. related to individual knowledge or others, at organization level strategic and tactical level constructs may be more meaningful to assess organizational TMS, as these have to enable future collaborations. Such assessment may include assessing the presence and effectiveness of artifacts that are created to
influence or represent strategic and tactical ostensive or performative aspects of TMS (cf. Fig. 5.1).

Second, while existing team-TMS assessment methods may be used to assess organizational TMS-subsystems (i.e. functional and networked TMS, and integrated and differentiated TMS for hybrid enactment) (cf. Fig 5.2), they do lack constructs and methods to assess the interlinking learning processes which tie the TMS-subsystems into a functioning organizational TMS.

Third, supporting the work of Majchrzak et al. (2007), who studied TMS development among emergent response groups (thus, at inter-organizational level), the three empirical studies of this dissertation (at organization level) illustrate that for the execution of a complex task not all members do have to know each other equally well: although all contribute and none of these contributions can be missed, the contributions are complexly related, not linearly. To perform well, actors need to (get to) know the actors with whom they directly interact, but may not need to know as well actors further away in the network.

The consequence of these three observations is that at organization level the construct of convergence is of limited value. Hence, future research should be aimed at developing new constructs and assessment methods to assess the state of development of organizational TMS.

5.5 Implications for Related Theories

The extensions made in this dissertation to TMS theory draw attention to a number of theories. In the following paragraphs the relations between organizational TMS theory and these adjacent theories are being explained, which results in additional directions for future research.

5.5.1 Hybrid enactment versus ambidexterity

In the Frisau study, hybrid enactment has been defined as the capability of an organization to engage in temporary networked mode of operating, in addition to their regular functional mode of operating. Similarly, ambidextrous organizations are defined as organizations
capable of simultaneously engaging in both routine and non-routine tasks (Adler et al. 1999; Raish et al. 2009). Raish and Birkinshaw (2008) distinguish five types of routine versus non-routine tasks, i.e. modes of organizational learning (single vs double loop), technological innovation (incremental vs radical), organizational adaptation (stability vs transformation), strategic management (autonomous vs induced), and organizational design (efficiency vs effectivity). Each of these streams of research shares a tension between exploiting and exploring. To better understand the nature of ambidexterity it is useful to note that ambidexterity is a form of dynamic capabilities (cf. Jansen et al. 2009; O'Reilly Tushman 2008). The latter concept is defined as: ‘The firm’s processes that use resources [...] to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die’ (Eisenhardt and Martin 2000: 1107). This definition elicits the distinction with hybrid enactment. In contrast to engaging in two modes of enactment to adapt to the changing environment of the organization, and thus, increase the lifespan of the organization, both modes of hybrid enactment (functional and networked) are aimed at solving here and now problems (or capitalize on opportunities). In addition, a hybrid organization may develop ambidextrous capabilities such as described by Raish and Birkinshaw (2008). Thus, hybrid enactment as presented in this dissertation represents a new theoretic perspective on ambidextrous modes of organizing, i.e. enabling an organization to switch (here and now) between modes of organizing to suit the problem or opportunities at hand. The consequence for theory is that ambidexterity should not only be approached from a dynamic capabilities perspective, but also from the perspective of the capability of organizations' to temporary combine its resources (i.e. combinative capabilities perspective) (cf. Bosch et al. 1999; Matthews and Cho 2001).
5.5.2 *Structural holes: competitive advantage and threat*

Structural-hole theory holds that connections between groups, if few in number, are a source of (competitive) value because these connections are able to control the flow of information between them (Burt 2005). Thus, the one occupying the privileged position of the structural-hole functions as information broker between the otherwise detached groups.

Analysis of the Frisau-case illustrates that structural holes not only represent opportunities to link independent sections of collaborative network. They also threaten the robustness of collaborating teams in case the success of the collaboration depends on such structure hole position. In the Frisau-case, for example, the position of the overall team leader was compromised while no one was able to reestablish contact with members of other collaborating teams without him.

The consequence for structural hole theory is that the function of structural holes should not only be studied from the perspective of opportunities to interlink disparate units and control the flow of information between them, but also from the perspective of threats due to potential disintegration of cross-team collaboration.

5.5.3 *Patterns of actions versus patterns of actors: orchestration*

Just as organizational TMS theory is enriched by organizational routines theory, organizational routines theory can learn from organizational TMS theory. Where the latter describes patterns of actors, the former describes patterns of action. Both are part and parcel of organizational tasks. Further integration of the two theories may help organizations to learn to switch not only between patterns of actions (i.e. alternative action repertoires) but to switch between actors capable of delivering these services as well. Such switching, known in the management literature as orchestration (*cf.* Busquets 2010; Rethemeyer and Hatmaker 2007; Sirmon *et al.* 2010), may contribute to the robustness and resilience of networked operations.
5.5.4 Organizational TMS as micro-foundation for KBT

In theoretical terms the strategic management perspective behind exploring and exploiting distributed knowledge resources for collaborative action is known as the resource based theory of the firm (RBT) (Barney 1991; Penrose 1959), or more specific, by its derivative, the knowledge-based theory of the firm (KBT) (Barney 2001; Spender and Grant 1996). The services that (knowledgeable) resources can provide are known as capabilities or competences (Sanchez and Heene 1997; Tsoukas 2000). Capabilities of an organization to integrate differentiated capabilities into (novel) services are known as combinative capabilities (Bosch et al. 1999; Matthews and Cho 2001). These combinations may result in new knowledge and new capabilities (McEvily and Zaheer 1999). Capabilities of an organization to adjust to its changing environment are known as dynamic capabilities (Wang and Ahmed 2007). Where KBT describe how the development of capabilities contributes to the strategic positioning of an organization, it remains salient about how resources, processes, and interactions among these resources and processes contribute to the development of capabilities (Foss 2011). That is, how do organizations develop specialized resources (differentiation) and prepare for the combination of these resources to deliver services (integration)?

To cater for this shortcoming, calls for micro-foundations for KBT are being made (Abell et al. 2008; Foss 2011). According to Felin et al. (2012) these micro-foundations should at least include three categories of micro-level components that underlay organizational capabilities, i.e. individuals, social processes, and structure. Although Kogut and Zander (1992: 398) note that a 'transaction is an insufficient vehicle by which to examine organizational capabilities, because these capabilities are a composite of individual knowledge and social knowledge', TMS theory covers both, as well as the three categories of micro-level components that underlay organizational capabilities. Thus, organizational TMS theory as being developed in this dissertation explains how distributed knowledge resources become organized at organization level, i.e. how capabilities of distributed knowledge resources may be combined to deliver valuable services, which is the core contention of KBT.
5.5.5 TMS and shared mental models

The literature on shared mental models (SMM) is still in its infancy (Mohammed and Dunville 2001) and how SMM relate to TMS is still in debate. In this section a contribution is made to this discussion by projecting SMM as content of more integrated TMS for functional enactment, or as content of the integrated TMS for hybrid enactment when the models are shared across organizational (unit) boundaries.

Ellis describes a mental model as a 'psychological map, or organized structure of knowledge', which across individuals may differ in accuracy and similarity (Ellis 2006: 577). Mental models that are similar across individuals are known by a variety of constructs, including social cognition (Larson and Christensen 1993), collective mind (Weick and Roberts 1993), shared mental models (Orasanu and Salas 1993), and team mental models (Klimoski and Mohammed 1994). These various concepts only differ in their description of what is being shared and what is held in common, and 'exist to the extent that they are apprehended by team members' (Klimoski and Mohammed 1994: 426). From this perspective, ‘transactive memory is a team mental model about the distribution of knowledge in a group’ (Austin 2003: 867), and as such represents a subcategory of team mental models (Peltokorpi 2008). The latter is in line with the work of Ellis (2006), who studied team interaction mental models. Ellis (2006) suggests that team interaction mental models and TM are conceptually and theoretically distinct yet complementary, and positively related: where transactive memory has a differentiating function, team interaction mental models have an integrative function, as they provide the necessary common perceptions and language to enable differentiation. This claim, however, is also made by TMS theory, as it gives explicit recognition to the fact that shared knowledge and differentiated knowledge are integral to TM (Huber and Lewis 2010; Wegner 1986). In fact, Wegner used the phrase 'integrated transactive memory' to represent those items of information that are held by all team members, while the team members ‘are aware of the overlap as they do share label and location information as well’ (Wegner 1986: 204).
Based on the findings of this dissertation, two contributions to this discussion can be made. First, rather then conceptualizing TM as a subcategory of SMM (Peltokorpi 2008), or explaining the conceptual and theoretical distinction between the two in terms of their complementary function (integrative versus differentiating) (Ellis 2006), SMM should be put on par with integrated transactive memory. That is, SMM are a form of integrated memory, which through the three TMS processes of information allocation, updating, and access coordination, become transactive. As such, integrated transactive memory make communication more efficient (Carlson and Zmud 1999) as it increases the likelihood of comprehension (Cramton 2001), decreases the need for knowledge exchange (Grant 1996), and allows participants ‘to formulate their contributions with an awareness of what their addressee does and does not know’ (Krauss and Fussell 1990: 112). Through these functions it permits actors ‘to share and integrate aspects of knowledge which are not common between them’ (Grant 1996: 115). From the perspective of SMM, putting SMM and integrated transactive memory on par helps to explain the emergence of SMM.

Second, integrated transactive memory (and thus SMM) may be restricted to a group TMS, but may also be developed among groups, i.e. through the development of an integrated TMS for hybrid enactment (cf. Figure 5.2). The construct of an integrated TMS for hybrid enactment lifts the concept of SMM from team level (i.e. the traditional unit of analysis in SMM research) to organization level.

5.5.6 **TMS development versus task- and team-familiarity**

Within the contexts of team mental models (cf. previous paragraph), Espinosa et al. (2007) found that task-familiarity and team-familiarity are substitutive, but not complementary. These findings are highly relevant for TMS theory, as Task-Context-Expertise-Person (TCEP) combinations form the basic building blocks of TMS. The findings of Espinosa et al. (2007) suggest that TMS may be based on either knowledge of the task or knowledge of expertise-person distribution
in the group. This conclusion, however, is not entirely consistent with extant TMS research.

Studying the role of communication in TMS development, Kanawattanachai and Yoo (2007) found that during the initial and developing phase of TMS development, task-oriented communication has a positive impact on virtual team performance. In well-developed TMS, however, communication related to task-knowledge coordination does positively influence virtual team performance. Thus, where in the early phases of TMS development task-familiarity is being developed, in well-developed TMS the focus shifts to team-familiarity. This finding is in line with the three successive meta-knowledge learning methods identified by Wegner (1987), i.e. learning through stereotyping, perception and self-disclosure, and through gaining first-hand knowledge of actors’ access to information, thus, gradually replacing task-familiarity with team-familiarity.

In the Frisau-case, team-familiarity was restricted to the members of the same team. Hence, collaboration with the other teams was based on task-familiarity, while the other teams were only known in terms of stereotypes and perceptions. As long as the operation continued in a routine fashion, task-familiarity was sufficient – confirming the findings of Espinosa et al. (2007). When the planned routine operation shifted to an unexpected non-routine operation, however, cross-team team-familiarity could not compensate for the lost task-familiarity, because the cross-team TMS (TMS for networked enactment) had not been developed that far. Thus, analysis of the Frisau-case suggests that the two types of familiarity may be complementary in situations in which one of the two collapses.

5.6 Implications for Practice

The findings of this dissertation have several managerial consequences. In the following paragraphs they have been categorized in interventions related to organizational design, and interventions related to system governance.
5.6.1 Organizational design

The main finding with consequences for practice concern the composite structure and functioning of organizational TMS, summarized in Figure 5.1 and 5.2, and the finding that organizational TMS are susceptible for interventions which should be aimed at strategic and tactical level. Four consequences for organizational design are being identified, i.e. related to potential switching capabilities, dissonance reduction, differentiated and integrated TMS for hybrid enactment, increasing potential transactivity among knowledge resources.

Potential switching capabilities

Hybrid enactment describes how an organization can switch dynamically between functional and networked enactment, depending on the problem situation at hand. When strategic level principles sufficiently overlap (i.e. are present in the integrated TMS for hybrid enactment), organizational units may be able to divide responsibilities, but work more or less separately (e.g. fire brigade and police: the former fights the fire, the latter secures the area). When in addition tactical level organizational structures and routines sufficiently overlap, tasks may be more integrated (e.g. surgeon and assistant: the former operates, the latter hands on the instruments). Both examples are compositional in effect: the joint efforts result in new capabilities (cf. Kozlowski and Klein 2000). If in addition operational level knowledge and skills overlap, compilational forms of collaboration are possible. One example is provided by the observation team (OT) studied in Chapter 4: tasks are dynamically switched among team members, depending on the position and behavior of the suspect being observed and e.g. the position of the various team members. Thus, overlap at various levels of agency determine the nature of the combinations that can be made between task, context, expertise, and persons.

As shown in Operation Vigilance and Operation Frisau temporary strategic and tactical level constructs may be added ex ante the operation, and even during the operation. Moreover, before a collaborative operation starts, Task-Context-Expertise-People (TCEP) combinations should be
checked on overlapping, complementary or conflicting TMS components in order to avoid vertical and horizontal dissonance.

**Dissonance reduction**

Knowing in practice within collaborative networks does not only concern operational and tactical cross-team sense making and understanding (e.g. Orlikowski 2002), but may also include the (conscious or unconscious) integration of strategic level governing principles. Strategic, tactical, and operational level TMS-constructs together form knowledge patterns, which emerge in support of patterns of action. During action, however, dissonance may occur among these levels of agency (Bacharach *et al.* 1996) (which I typified as vertical dissonance). In case of hybrid enactment it may be expected that enduring TMS for functional enactment are well established, and that consequently vertical dissonance in these teams is low. The patterns that developed, however, may need adjustment for networked enactment (i.e. temporary collaboration). This may induce dissonance within (vertical dissonance) and among the collaborating teams (horizontal dissonance). Hence, contrary to the perspective of organizational TMS as a collection of group TMS (Jackson and Klobas 2008), measures may be needed to solve conflicting strategic or tactical elements that may hinder effective collaboration. Organizational designers may facilitate dissonance reduction by developing meta-routines for integrating cross-team strategic and tactical TMS-elements.

**Differentiated and integrated TMS for hybrid enactment**

Hybrid enactment is served by a well-developed differentiated TMS for hybrid enactment and a well-developed integrated TMS for hybrid enactment (*cf.* Figure 5.2). Differentiated TMS for hybrid enactment may regularly develop during management (and specialist) meetings in which shared problems and opportunities are being discussed, and during collaborative actions in which capabilities of others can be experienced out of first hand. Its development may be stimulated by introducing boundary-crossing practices (e.g. paying field visits to
participating units or organizing opportunities to learn to know each other) (cf. Jansen et al. 2009, and Chapter 3). Integrated TMS for hybrid enactment are more costly, as they involve larger numbers of participants. Next to general selection criteria for new organizational members, such as educational background, the development of integrated TMS for hybrid enactment can be stimulated by e.g. creating shared explicit coordination mechanisms, such as task organization and team communication (cf. Espinosa et al. 2007). In addition, boundary objects such as the iFunnel (cf. Chapter 2 and 3) can be used to improve coordination and synthesis across heterogeneous disciplines (cf. Bechky 2003; Carlile 2004).

Increasing potential transactivity among knowledge resources

TMS develop through informational interactions (or transactions) related to the cognitive division of labor (Ellis 2006; Wegner 1986). Opportunities to engage in informational interactions, however, may be limited. As shown in Operation Frisau (cf. Chapter 4), alternative communication channels and means were sought to compensate the problem of exclusive link failure. Transactivity, however, does not only refer to informational interactions among people (personalized knowledge resources). In an organizational setting, transactivity may be increased among various types of knowledge resources. Transactivity among artifacts (e.g. iFunnel, Chapter 2 and 3) and people, for example, may be increased by providing access alternatives and formats. In this respect it should be noted that artifacts are not part of the organizational TMS, but may be used to influence or represent the ostensive or performative aspects of organizational TMS. People may choose to use it, but may equally well decide to use the artifacts in unintended ways, totally ignore it, or use alternative methods or means to achieve their goal. When needed, critical TMS processes may be locked-in, in fully automated routines, thus creating 'dead TMS'. These artifacts may serve as boundary object and as such may compensate for lost flexibility.
5.6.2 **System governance**

System governance exceeds interventions in the organizational design, which represent second order problem solving (Boonstra 2004; Kooiman 2008). In addition, system governance is concerned with first order (day to day problem solving) and third order problem solving (establishing the governing rules by which the system is governed) (Kooiman 2003, 2008). Kooiman stresses the socially constructed and ongoing nature of governance by defining the verb governing:

> Governing can be considered as the totality of interactions, in which public as well as private actors participate, aimed at solving societal problems or creating societal opportunities, attending to the institutions as contexts for these governing interactions, and establishing a normative foundation for all those activities (Kooiman 2003: 4).

Following this definition he continuous by saying that '[g]overnance can be seen as the totality of theoretical conceptions on governing' (Kooiman 2003: 4). Although Kooiman addresses governance at governmental level, it may also be applied at organization level. The establishment of a normative foundation represents strategic level agency, while the institutions that serve as contexts are represented by tactical level organizational structures and routines, are established through tactical level agency. Both levels of agency serve two purposes, i.e. providing a platform for 'solving societal problems or creating societal opportunities'. As these problems and opportunities are ongoing, so is system governance. In the following sections the types of interventions uncovered in this dissertation are being addressed. First interventions aimed at strengthening the ostensive aspects of organizational TMS are being discussed, followed by interventions aimed at strengthening the performative aspects of organizational TMS.
5.6.3 Governing the ostensive aspects of organizational TMS

In the following paragraphs five findings are discussed with respect to the strengthening of the ostensive aspects of organizational TMS (which in turn enable and constrain the performative aspects of organizational TMS).

First, like was done in Operation Vigilance (Chapter 3) the ostensive aspects of organizational TMS may be strengthened by creating opportunities to practice (cf. Moreland et al. 1998), which may be complemented with priming, defined as providing network actors with a description of the capabilities of others in the network (Moreland and Myaskovsky 2000). Temporary networked operations, too, contribute to the development of organizational TMS, one, because individual members develop their personal meta-knowledge of 'who knows what', and two, because both differentiated and integrated TMS for hybrid enactment are being developed, which moderate the success of assembling future temporary collaborations.

Second, where Espinosa et al. (2007) found that team-familiarity and task-familiarity are substitutive in their effect on team performance, but not complementary, the analysis of Operation Frisau revealed that in situations in which one of the two shared mental models collapses, the other could compensate and thus, could be complementary. The implication for practice is that collaborative networks may be strengthened by investing in both team-familiarity and task-familiarity related to interdependent tasks.

Third, in addition to cognitive-based trust, affective-based trust (used to represent what Robinson (1996) describes as “expectations, assumptions, or beliefs about the likelihood that another’s future actions will be beneficial, favorable, or at least not detrimental to one’s interests”) is an important moderator influencing team success. In a hierarchical command-driven environment, such as the police, fire-brigades, or the army, this may seem trifling, but these professionals regularly engage in high-risk assignments. Supported by the work of Rosen et al. (2007), who found that lack of trust is one of the main barriers for distributed team
success, organizations engaging in hybrid enactment should pro-actively invest in both cognitive-based trust and affective-based trust.

Fourth, based on the research findings of the third empirical study I hypothesize that awareness about the nature and dynamics of virtual team settings and temporary collaborative action will strengthen the ostensive aspects of the organizational TMS, and thus collective performance. In particular awareness should be increased about:

1. differences in strategic, tactical, and operational level knowledge patterns associated with functional enactment (representing their comfort zone) and networked enactment (representing a potentially fragile zone of potentiality);
2. contextual strategic and tactical realities of the teams involved;
3. potential sources of dissonance (within and among the participating teams) and instructions how to handle them;
4. the network horizon regression effect, when under stress; and
5. the level of agency regression effect, when under stress.

Finally, as shown in Figure 5.1, the ostensive aspects of organizational TMS may be influenced through the design of artifacts. Especially in the case of hybrid enactment boundary objects may be used to increase familiarity of tools or methods used in networked operations.

5.6.4 Governing the performative aspects of organizational TMS

Like the ostensive aspects of organizational TMS, the performative aspects may be influenced through the design of artifacts (after which the performative aspects in turn create and recreate the ostensive aspects of organizational TMS). Based on the empirical data collected in this dissertation I discuss three examples. The first artifact that was developed to influence the performative aspects of the organizational TMS was the iFunnel (cf. Chapter 2 and 3). In fact, part of the TMS system and the substantive knowledge required to identify drug traffickers on highways was fully automated. This division of labor (process of allocating), complemented with automated processes of
accessing other data sources (e.g. RDW) and updating people (through screen messages and SMS) to direct interception, did have a significant effect on collective performance. The second artifact concerned an explicated method, ILP+, which was used to structure the process from explicating implicit knowledge to indicators which could be shared with officers along the road and of which some could be processed by tools such as the iFunnel. Finally, in the AR reported in Chapter 3 a method was developed to analyze formal and informal relational networks (Figure 3.3). These diagrams may be used to identify risky exclusive links and alternative patterns of actors ex ante the collaborative operation, and thus influence the course of action.

5.7 Limitations

Several limitations of the dissertation may provide opportunities for future research. They can be divided in limitations related to the applied research methods, and limitation related to research context.

5.7.1 Limitations related to the applied research methods

In this section I discuss two limitations related to the applied research method. First, there is the known limitation of generalizability in qualitative research. Each of the three empirical studies was aimed at understanding a problem situation and draw theoretic and managerial lessons from it – not to study the full range of variety of such problem situations. Hence, although some of the findings of this dissertation may be generalizable, more research is needed to broaden the base of empirical evidence. Second, in absence of organizational TMS assessment methods, organizational TMS in this dissertation is being assessed based on observations related to task-interdependence and performance, and in the third empirical study based on TEP-combinations and context (TCEP) and TCEP-state at the various levels of agency. More research should be conducted to develop an organizational TMS assessment method which includes not only the ostensive and performative aspects of the organizational TMS and its subsystems, but also the artifacts that are in
use to influence or represent the related ostensive and performative aspects.

5.7.2 Limitations related to the research context

All three studies were explorative in nature and conducted within one organization. And although project initiatives and operations studied in this dissertation are quite representative for project initiatives and operations within the KLPD, variety is certainly much higher. This variety includes three aspects, i.e. types of knowledge resources, organizational context, and types of interventions to strengthen the organizational TMS. First, in this dissertation circa 10 types of teams and organizational subunits have been studied, a limited number of structures and routines, and among other IS, one system which has been developed to process complex geographically distributed events (iFunnel). The KLPD, however, is home to over a 100 different types of expertise, while within the field of public safety and security, work is often executed in collaborative networks that encompass an extensive range of public and private partners. Likewise, 100s of information systems and registers, structures and routines are being used, which in one way or another play a role in the 'information ecology' of the organization (cf. Davenport and Prusak 1997; Jones et al. 2005). Hence, variation in knowledge patterns covered by organizational TMS is many times higher than studied in this dissertation. Studying these diverse patterns is a promising area for better understanding the functioning of organizational TMS, and for identifying opportunities to strengthen them. Second, more research is needed to study organizational TMS in different contexts. Examples within the police included crisis response situations or large scale public order events. Examples of different partners include other types of specialist teams, organizational units such as collaborative control and command centers, and external partners. Finally, within this dissertations interventions are being discussed as taken – not as a range of potentially effective interventions. Hence, the range of alternative interventions is many times larger then has been studied.
5.8 Future Research Directions

Besides future research directions stemming from the limitations of this dissertation, five leads have been identified that are discussed below.

5.8.1 Archetypes of interdependence

With the inclusion of levels of agency, the concept of TMS structure has been refined. For example, while TMS may be more integrated at strategic and tactical level, a TMS may be more differentiated at operational level, meaning that allocation of roles may be more flexible. Using these two characteristics (TCEP-state and TMS structure (differentiated vs integrated)), archetypes of interdependence within teams may be identified (see Table 5.2). These are explained next.

<table>
<thead>
<tr>
<th>Static TCEP-state: all roles are fixed</th>
<th>Homogeneous teams</th>
<th>Predictable interdependence teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>everyone knows and does the same.</td>
<td>E.g. ME peloton</td>
<td>everyone is specialized and knows how their work relates to that of others.</td>
</tr>
<tr>
<td>E.g. Operation Frisau</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dynamic TCEP-state: all roles are flexible</th>
<th>High redundancy teams</th>
<th>Unpredictable interdependence teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>everyone knows the same but attends different aspects of the shared task.</td>
<td>E.g. Observation teams</td>
<td>everyone brings in expertise, but does not know how this relates to that of others.</td>
</tr>
<tr>
<td>E.g. Observation teams</td>
<td></td>
<td>E.g. improvisation, major crisis</td>
</tr>
</tbody>
</table>

Table 5.2: Archetypes of interdependence within teams

First, teams with a more integrated TMS (left column of Table 5.2) are characterized by overlap in knowledge. In high redundancy teams, such as observation teams studied in Chapter 4, the integrated TMS at strategic and tactical level enables the team to dynamically rotate tasks.
at operational level. Homogeneous teams, such as ME pelotons, are characterized by similarity of all three levels of agency. The integrated nature of the supporting TMS of high redundancy teams and homogeneous teams enables them to scale the size of the operation/team with the (evolving) task at hand. Teams with a more differentiated TMS may start from the situation in which interdependence is known (i.e. predictable interdependence teams), while the team is challenged to maintain coherent (which failed during Operation Frisau). They may also start from a situation in which interdependence is unpredictable (unpredictable interdependence teams), thus challenging the team to make sense of their interdependencies (as was the case in Operation Vigilance).

Based on these exemplars, I hypothesize that different principles (strategic level agency) and coordination mechanisms (tactical level agency) may be used to enable and sustain collaboration within these different types of teams. These may include, but are not limited, to mechanisms used to reduce vertical and horizontal dissonance. For example, the national forensic investigations team (LTFO)\textsuperscript{8} consists of a small permanent team of circa 5 officers, which may be complemented with members of regional forensic investigations teams in case of larger, or multiple crisis situations (i.e. a high redundancy team). To prepare for collaborative action bi-annual collective trainings are organized, while tactical level structures and routines of the LTFO overrule the tactical level structures and routines of the regional teams. These overruling structures and routines are explicitly communicated during these trainings, and ex-ante every actual operation. Future research should uncover what kind of other synchronizing and coordinating mechanisms in these inter-organizational TMS are being used, or may be used to strengthen temporary distributed collaborations.

5.8.2 Gaps in organizational TMS literature

The positioning of TMS studies in relation to organizational TMS as depicted in Figure 5.3 brings to light areas of research which have not

\textsuperscript{8} Source: interview teamleader LTFO
been addressed yet. This includes the initiating effects between differentially TMS for hybrid enactment and TMS for networked enactment, the direct effects between TMS for functional versus TMS for networked enactment, and the moderating effects of differentially and integrated TMS for hybrid enactment on the forming and functioning of temporary collaborations. Moreover, it brings to mind questions about TMS processes at organization level. Apparently functional differentiation exists between different types of TMS within organizations (i.e. TMS for functional enactment, for networked enactment, and differentially and integrated TMS for hybrid enactment). More research is needed to understand how the processes of information allocation, updating, and access coordination at organization level differ from those at lower levels of analysis. These questions, together with the model of organizational TMS as developed in this dissertation (Figure 5.2), represent angles to study how multi-activity tasks affect organizational TMS, which coincides calls for research made by Lewis and Herndon (2011).

5.8.3 Organizational TMS and learning

Second, and in addition to the first, when approached from a TMS learning perspective, the implied sequential relation between the TMS learning methods identified by Wegner and his colleagues (1991) may have to be reexamined. Wegner et al. (1991) identify three progressively sophisticated learning methods through which distributed expertise becomes known. People gain almost instant knowledge about someone’s capabilities through stereotyping, such as inferences from roles, uniforms, posture, age, or sexe (Hollingshead and Fraidin 2003). Perceptions are further developed by self-disclosure of traits, skills, past activities, preferences, and emotions. In the third method knowledge about the actor’s access to information includes facts, like knowing who accessed a source and who has accessed it for the longest period of time or most recently. One question that the interpretive case study of operation Frisau raises, is whether these learning methods are necessarily sequential. Where in enduring functional teams this may be the case, in Operation Frisau the teams at the tactical level worked together based on role-
perceptions, while at the operational level it was clear to everyone who had access to which information. To better understand how TMS for networked enactment can be strengthened effectively, without requiring high investments associated with the most sophisticated learning method, more research is needed. This could support the allocation of organizations’ knowledge investments.

5.8.4 Taxonomy for organizational TMS development

Third, where this dissertation furthered our understanding of how the various types of knowledge resources are related to organizational TMS, more research is needed to better understand how within various contexts various types of knowledge resources can be used to strengthen organizational TMS (e.g. by transforming personalized knowledge to encoded knowledge) (cf. Chapter 2). During the course of this dissertation I made a first attempt to develop a taxonomy for organizational TMS development (see Appendix 2). Research is needed, however, to study the relevance of this taxonomy for organizational TMS development.

5.8.5 Organizational TMS in relation to divergent epistemologies

Fourth, in a paper about knowledge-based policing (Schakel et al. 2012), in which the iFunnel (cf. Chapter 2 and 3) is being discussed from a juridical and ethical perspective, the problem of divergent epistemological perspectives between officers in the field (predominant interpretive-constructivist perspective) and information analysts at the office (predominant positivist perspective) is being addressed. It is concluded by Schakel et al. (2012) that these different epistemological perspectives hinder the integration of distributed knowledge resources. Following this observation the integration of knowledge resources which are founded on divergent epistemological perspectives forms an interesting area of research with respect to the coherent functioning of organizational TMS.
5.8.6 System governance

Finally, the introduction of levels of agency draws attention to system governance. System governance is generally aimed at two aspects, i.e. performance and control (Weill and Ross 2004). In this dissertation the focus was on increasing performance, while control was used in the sense of increasing operational robustness and resilience. The interventions discussed in this dissertation show that organizational TMS are in principle governable (cf. Kooiman 2008). Following Kooiman (2008), this involves three elements, i.e.: organizational TMS may be viewed a system-to-be-governed for which an organization may develop a governance system, while the two are interrelated through governing interactions. While Figure 5.1 and 5.2 present the elements of the system-to-be-governed, future research attention should be given to outlining the contours of a governance system and the types of governing interactions that can be applied to improve the system's performance and control, i.e. guide the exploration and exploitation of distributed organizational knowledge resources in collaborative action.