TASK INTERDEPENDENCE AS ENABLER IN DISCERNED TEAM PERFORMANCE EPISODES EFFECTING INNOVATIVE OUTCOMES IN PARTIALLY DISTRIBUTED GLOBAL TEAMS

A CATEGORISATION-ELABORATION PERSPECTIVE

Inauguraldissertation
zur Erlangung des Grades eines Doktors der Philosophie
im Fachbereich 05 Psychologie und Sportwissenschaften
der Johann-Wolfgang-Goethe-Universität
zu Frankfurt am Main

vorgelegt von

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2015 (Einreichungsjahr)
2016 (Erscheinungsjahr)

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There is no more magic in the fact that groups have properties of their own, which are different from the properties of their subgroups or their individual members, than behind the fact that molecules have properties, which are different from the properties of the atoms.
(Lewin, 1947a)

Acknowledgements:

I would like to thank my family for their support and their unconditional love. My love Paula for her incredible patience, support and love in all different phases of working on this thesis.

A special thank has to be dedicated to my first supervisor Prof. Dr. Holger Horz at the Goethe University Frankfurt who made this thesis possible and was a great support, especially, regarding his expertise in quantitative research methods.

Furthermore, I would like to thank my mentor Prof. Dr. Hartmut Schulze at the School of Applied Psychology of University of Applied Science Northwestern Switzerland for his support, and for giving me the opportunity to learn about qualitative-heuristic research in the respective studies. A special shout out has to be made to my work colleagues and friends at the School of Applied Psychology, especially, Connie, Julia, Magda, Melanie, Simon and Zsofia.

A special dedication goes out to my friend Dr. Sebastian Ulbrich, who helped me a lot in developing my ideas and acted as a great informal motivational coach.

Furthermore, all the students, who took part in the course module on intercultural and virtual collaboration, have to be mentioned for providing insights in the reflexive dialogues of the module, which enabled further refinements of research questions.

And of course many thanks to all the other people who supported me, and I have forgotten now!
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1 Zusammenfassung


2 Introduction

From an early understanding of organisational theorist (Bartlett & Ghosal, 1989; 1990), the function of global teams in transnational organisations has been conceptualised as the transformation of different embedded cultural practices for the development of a global strategy, products and services. Simultaneously, in the field, from the beginning of the 1990ies to the edge of the new millennium neo-liberal political developments enforced a free flow of capital on a global level (cf. Turner, 2006). In line with the development of respective connectivity via the internet the form of globally distributed team work was spread (Maznevski & Chudoba, 2000). In a study by Biggs (2000), published just after the millennial change, it was shown that 60% of tasks in multinational companies are accomplished by virtual teams. More recent data (Society for Human Resource Management, 2012) showed that the prevalence of such teams stayed more or less constant in the last 10 years. According to the survey 66% of companies are working with distributed global teams.

Globally distributed teams were already described by Bartlett and Ghosal (1989) in their functions of articulation and translation of differing market practices for the integration of requirements and needs on a global level. From a European perspective the importance to further develop innovation capabilities in order to compete in the global market is stressed today (Imp3rove, 2012). In a globalised economy not only the big multinational companies are involved in globally distributed research and development activities (R&D). On the level SMEs, for example, in Switzerland the involvement in global development processes is increasing (Gassmann, 2009). From my own experiences in working with Swiss SMEs, the macro-economic processes in regard to the strong Swiss Franc may accelerate such processes. Thus, the form of globally distributed teams, and their functional task in global development processes, can be viewed as highly relevant, in a globalised economy.

The crucial question for companies at the moment is, if teams can be enabled for innovative project work, which enables the integration of diverging perspectives in a globally distributed setting? Or, if such teams have to be collocated for more innovative, interdependent task work? Requirements for integrating embedded knowledge from different regionally defined clusters into global innovations at least, seems to indicate for the relevance of interdependent globally distributed team work (cf. Li, Eden, Hitt, Ireland, & Garrett, 2012). Bilateral practices of partnering, for example in the Swiss pharmaceutical sector, lead to the integration of selected subsidiaries in the R&D process of the company (Festel et al., 2010). Thus, the form of dispersion for project teams becomes more critical for effective global R&D practices (Boyer O’Leary & Cummings, 2007). So called partially distributed
teams integrating balanced subgroups between two sites, hence, become an important subject of inquiry with practical relevance.

The context of partially distributed team work represents by virtue a context involving multiple perspectives influenced by the involvement of actors stemming from different cultural contexts (Dekker, Rutte, & Van den Berg, 2008). It thereby provides the synergetic potential for integrating different perspectives in the resolution of complex problems on a global level (Janssens & Brett, 2006). Simultaneously, cultural diversity engenders challenges for collaboration. Challenges, like different understandings and interpretations regarding tasks, the structuring of communication (Maznevski & Chudoba, 2000) and unexpected events occurring in the collaboration between the actors (Dekker et al., 2008; Oertel & Antoni, 2014) were identified in respective empirical studies.

Opportunities and challenges of partially distributed global teams can be compared with the problematic of face-to-face (f2f) teams with a moderate amount of diversity. Studies have shown (see Thatcher & Patel, 2011 for a meta-analysis) that when the distribution of diversity characteristics is aligned to potentially form culture specific subgroups, so-called diversity faultlines (Lau & Murnighan, 1998), negative subgroup dynamics are reinforced.

To achieve the above mentioned synergetic potentials it seems important to effectively cope with such negative dynamics and allow for a balanced participation in partially distributed teams (Janssens & Brett, 2006). In the research on faultline teams, especially the structuring of task-related interdependences across respective subgroups has been identified as an important impediment for the mentioned subgroup dynamics. Task interdependences, which cross functional roles across respective group faultlines (Bettencourt, Molix, Talley, & Eubanks, 2007; Marcus-Newhall, Miller, Holtz, & Brewer, 1993), are able to unlock the inherent potentials of globally distributed teams on more complex tasks that require the integration of different perspectives. From a work group diversity perspective (van Knippenberg & Schippers, 2007), partially distributed global teams represent a research object for studying the interaction between social categorisation processes involved in the above mentioned subgroup dynamics, and processes of task-related information processing required for innovative team outputs. The exploration of effects of task structures on the interaction between categorisation processes and task-related information processing (van Knippenberg et al., 2004), will be in the main explorative research focus of this thesis. The research thesis represents a heuristic explorative inquiry (Kleining & Witt, 2001) of respective dynamics and structural as well as process-related enablers.

The thesis starts with the theoretical part, in which the historical development of the understanding of teams as open, complex and temporally dynamic systems (Arrow et al., 2005, 2000), will be outlined. A sound definition of partially distributed global teams, including the respective contextual characteristics will be delineated. In a sensitizing framework (Blumer, 1954) which guided the
explorative research process, the central boundary condition of task interdependence (Wageman, 2001) and respective episodic theories for explaining global task-related dynamics in teams (Marks et al., 2001), the dynamics of social categorisation (Gaertner, Dovidio, Anastasio, Bachman, & Rust, 1993; Gaertner & Dovidio, 2000), as well as the interaction between social categorisation processes and task-related information processing will be integrated (van Knippenberg et al., 2004). According to the framework, empirical studies on effects of task interdependence on interactions between task-related information processing and social categorisation processes will be addressed (van Knippenberg et al., 2004).

The empirical part of the contribution will be split in two parts. In the first heuristic exploratory study eleven partially distributed global teams are followed up during the time of relevant innovation projects. The approach allowed the study of task interdependence, productive interactions with social categorisation processes and there effects on team innovation. In the second empirical step, the developed hypotheses, were tested in an experimental simulation (Arrow et al., 2005, 2000) in undergraduate courses.

As a conclusion of the two exploratory studies, an episodic team process model will be outlined. The model specifies interdependence dynamics, which allows for team innovation. Furthermore, on a process level, the episodic categorisation-elaboration model (van Knippenberg et al., 2004) proposes three critical team performance episodes. Dynamics in the interplay between task-related information processing and social categorisation processes allow for the development of hypothesis for further research projects. Finally the implications for theory and the practical relevance of the heuristic model will be discussed.
3 Theory

The theory section is partitioned in a more conceptual part, in which first of all the understanding of teams in the sense of open, complex and temporally dynamic systems will be historically outlined (Arrow et al., 2005, 2000). To come up with a sound concept of partially distributed global teams, the research object will be defined in detail. The second part of the theoretical arguments will focus more specifically on empirical work in regard to related effects of central enablers such as structural task interdependence (Wageman, 2001) on global rhythms of task work, and local interactions between social categorisation process and task-related information processing (van Knippenberg et al., 2004) in structuring team performance episodes (Marks et al., 2001).

3.1 Towards an understanding of teams as complex adaptive systems

For the further theoretical arguments within this thesis a definition of teams will be taken into account which tries to understand group phenomena in a holistic way. In the following paragraphs of this chapter the historical foundations of such conceptualisation of groups in a working context will be traced.

3.1.1 Opening the field for research on group dynamics - Kurt Lewin

Historically the holistic understanding of groups and their effects is drawn back to the investigations made by Kurt Lewin (1947a, 1947b) on the frontiers of research in group dynamics in the 40ies of the last century. According to him groups become real as they develop structural properties defined as patterned relations between parts rather the parts or elements just standing for themselves. Such formations are dependent on the specific forces of the social context or the organisations the groups are operating within. The appearance of relational structures as well as group processes which are typical for a specific group is thereby defined by forces in the social setting, also called the social field. Such forces in the context of groups define the actually occurring processes in the group, also named as quasi-stationary processes by Lewin (1947a). To exemplify the notion of such quasi-stationary processes discrimination practices in groups can be taken as example. Such practices have to be seen as being in interaction with forces from overarching organisational or institutional practices, for example pre-existing intergroup conflicts. So when groups are experiencing a high level of intergroup conflicts higher degrees of intra-group homogeneity are achieved through group specific processes of demarcation of members from other groups and intra-group identification (Lewin, 1948). The notion developed by Lewin (1947a) shows that groups in so far can only be understood within the context in which they form and develop as systems of patterned relationships.
and processes. Such systems are developed by emerging collectively shared perceptions of the specific social situation.

In the second article on frontiers in group dynamics Lewin (1947b), in a more process-oriented stance, elaborates on the notion of groups as cyclical feedback loop systems. The problem of planned social action can only be understood as a system of circular feedback systems which guide the development of shared scripts and plans of group-related actions. The importance of flexibility of such action plans is highlighted for reasons of enabling processes of coping with unexpected situations during the actual team action phase. The range of achievement of each action step has to be evaluated after completion by specific evaluation mechanisms or institutionalised organisational control entities. The result of each action step influences further steps within a system of feedback loop cycles of approval regarding achieved results. Thus, social processes tend to have not a simple beginning or ending, they tend to be circular and have connections with other circular processes, like organisational control routines. Such nested circular processes can be understood as feedback systems which show some amount of internal self-regulation.

The concept of self-regulating feedback systems developed by Lewin (1947b) was highly influenced by the cybernetic theories of human-machine interaction developed in the Radiation Laboratories of the Massachusetts Institute of Technology (MIT) by Norbert Wiener (1961) and colleagues, like Arturo Rosenbluth, Vannevar Bush Julian Bigelow, Claude Shannon etc. (cf. Turner, 2006). Following the cybernetic theory, Lewin (1947b) conceptualised social systems as interrelated feedback systems between action and sense organs which seek to eliminate divergence between occurring actions and set goals. To achieve optimal feedbacks, which allow for a correct interpretation of information received from the environment, it seems important to enable accurate fact finding which facilitate a shared perception of the actual social situation and the determination of realistic social goals within a system. Such a system should track the direction achieved by a specific action taken to achieve the set social goal. The concept of directed social action which leads to a movement within social systems or locomotion, as Lewin (1947b) called it, led to the development of a theory of social change and a first concept of action research. This approach followed a paradigm which claimed that a real understanding of systems could only be reached by provoking a change within it. This paradigm guided Lewin's experimental research (see for example Lewin & Lippitt, 1938) as well as numerous field studies that were influenced by the ideas developed by him.
3.1.2 Work groups as open, self-regulating socio-technical systems

The focus on social change as well as the notion of self-regulation within smaller collectives, such as work teams, became important in a school which was highly inspired by Kurt Lewin's (1947a, 1947b) thoughts on group dynamics - the socio-technical school founded at the Tavistock Institute by Emery and Trist (1969). In their studies within the British coal mining sector, they identified a traditional group work structure which was able to a high amount of self-regulation of their work activities. The pre-mechanised or better to say pre-industrialised order of the organisation of the workers was managed through small work groups (Trist & Bamforth, 1951). The primary work organisation of this type enabled to place the responsibility for the complete coal-getting task on the shoulders of a small working group which experienced the whole cycle of operations. The work operation thereby became a joint activity which was autonomously led by formal as well as informal leadership structures within the group. Such holistically defined collective work tasks had the power to create self-regulation without strong hierarchical work control patterns. It could be shown that such a system of semi-autonomous work teams lead to a reduction of stress and an increase of performance. This was assigned to an increase in responsible autonomy (Emery & Trist, 1969). Self-regulation was promoted through the creation of a holistic skill set for the interdependent coal-getting task in the on-going interaction and collaboration with functionally differing workers. The system thereby found a stable state - an equilibrium - in the sense of the quasi-stationary processes in Lewin's work (1947a) in which it was enabled to adapt more efficiently to the changing underground conditions of the coal getting setting. Emery and Trist (1965) posited that autonomous work groups are a better organisational solution under conditions of environmental uncertainty and ambiguity.

The theory of socio-technical systems (Emery & Trist, 1969) explicitly claims that the form of autonomous groups does not fit to all working contexts. Work systems as social systems have to be seen as goal-driven systems which are enabled to achieve specific goals by different means, and which can adjust to different environmental conditions. The technological system thereby acts as an important boundary condition for processing inputs into outputs. In contrast to the conceptualisation of closed systems in the classical Newtonian physics, open systems are able to acquire multiple equilibria in a state where interchange processes with the environment enable the system to produce enough energy for survival and adaptation (von Bertalanffy, 1969). Socio-technical systems are conceptualised as open systems which interact with their environments by transforming inputs into outputs through their technological system embedded in specific social relationships (Emery & Trist, 1965). Therefore, the study of so-called boundary conditions (Emery & Trist, 1969), as interrelations between the environment and the socio-technical system are central for understanding the actual states and occurring processes within work groups.
In the studies in the coal mining sector (Trist & Bamforth, 1951) encompassing work relationships were reinforced by stable social relationships which extended the normal work setting and grounded in existing kinship and developing friendship structures. Similar to Lewin's (1947a, 1952) concept of social field the social and the technological system are seen as interdependent forces which influence the psychological wellbeing of workers in their respective work-spaces. Workers themselves can contribute to the determinants of their work by influencing the nature and quality of the attitudes and relationships in performing predefined task roles. The important connection between non-work related overarching social structures and the specific social and technical structures of the work situation, as well as the matching and joint optimisation became one of the main principles of the theory of socio-technical systems (Emery & Trist, 1969). Further design principles, such as the redundancy of functions, the criteria of minimal specification of work group conditions, etc. have been described elsewhere (see Mumford, 2006 for a historical review). For the conceptualisation of work groups or teams it seems more important to update the concept of work groups as open systems which are related to their social as well as technological environments in doing their task work. The technical system thereby can be seen as the main boundary condition - in form of an internalised input factor - which drives the process of input to output transformation of the organisation. The achievement of goals within a specific technical regime can be organised in different forms. In the socio-technical perspective it is important to respect existing social structures when introducing new technologies into systems, to optimize the technical as well as the social system. To achieve such a joint-optimisation, an understanding of the history of a specific work group and their established work cultures is required (Trist & Bamforth, 1951).

Beyond the development of a concept of socio-technical systems the studies in the British coal-mining industry are interesting because they represent one of the first investigations of spatio-temporal segregation of work. The mechanisation of the coal-getting activities in segregated shift and task roles required an integration of the technological whole as formalised in the new shift plans and segregated working tasks of the shift workers. Because of the shift plans both temporal and spatial dispersion, tasks did somehow preclude the reintegration into a new social whole. There was a loss of sense of interdependence through the segregated tasks in sequential and spatially separated work shifts. The segregation of work shifts being organised in interdependent functional pairs, which did not have the possibility to talk about conditions to miners from the shift before or after. Permanently changing conditions did increase the complexity of the task, making it more difficult to judge work productivity. This framed an intergroup setting between the respective pairs with conflicts (e.g. in regard to productivity) between the segregated functional roles of the coal getters.
The mechanisation of the coal-getting activities within Longwall created a spatio-temporal disintegration of tasks which had to be performed between subgroups which were not able to communicate in a setting. In such organisational structures intergroup relationships became super-imposed to and interacted with intra-group tensions for the fulfilment of the primary tasks of coal-getting (Trist & Bamforth, 1951). The studies done by members of the Tavistock Institute (Emery & Trist, 1969) point towards the importance of optimal organisation of task interdependences in regard to the requirements of the complexity of involved task for acquiring effective equilibria in work teams. The increasing ambiguities and the complexity of knowledge of workers today and their requirements for the organisation in globally dispersed settings will be of special importance within this contribution.

3.1.3 Process orientation in work and organisational psychology

According to the definition of groups by McGrath (1984), mutual awareness of each other and the potentiality of interaction are the requirements for the creation of a minimal sense of interdependence where members take into account one another by making their choices and taking their actions. Such a minimal account of interdependence allows for the acquisition of some degree of continuity over time and therefore creates a group history as well as the anticipation of a shared future. Furthermore, group size, the structure of the group, interrelationships with other groups as well as the range and content of group interaction processes define to what amount a collective is perceived as constituting a group as a whole. McGrath (1984, pp. 11) differentiated between standing group in the sense of the structural properties or patterned relationships (Lewin, 1947a) among individuals who are members of a group and the acting group consisting of the patterned team processes.

In the theoretical arguments on group processes lined up by McGrath (1984) again a notion of circularity which has some similarities to the concept of circular feedback systems described by Lewin (1947b) as mentioned earlier can be found. The development of what McGrath (1984, pp. 11) calls an acting group is seen as a circular process with extensive feedback loops. A standing group develops through the circular team processes which lead to a sense of awareness and potentialities for interaction - a sense of interdependence. On the other hand, the actual state of the standing group structure predefines the potential range and content of group interaction processes. Consequentially group interaction processes recycle in unchanging conditions, and adapt as group properties when being changed by previous interactions. Those group properties can be conceptualised according to McGrath (1984) as the major classes of inputs which shape the group interaction. Input factors are actually conceptualised as being in interaction with the setting where the group interaction
processes are actually happening and the outputs of the group processes themselves. The models
developed were consequentially titled Input-Process-Output models (I-P-O see also Hackman &
Morris, 1975).

Similar to the relevance of boundary conditions in the socio-technical systems theory (Trist &
Bamforth, 1951), according to the models proposed by Hackman & Morris (1975) and McGrath
(1964) group interaction processes have to be understood in the context of the physical, the
technical, the socio-cultural environment as well as according to the tasks being performed by the

The contextual setting in which team processes are occurring is not conceptualised as the
situation defining social interactions as primary predictor (Barker, 1968), but is seen as a pattern
which fits to the group as a structured entity of patterned relationships and team processes. The
contextual setting, thus, provides requirements, opportunities, possibilities as well as constraints for
interaction and can be structured by developed patterns of the group as well as by external entities
in the group's environment (McGrath, 1984). Groups are defined as open and adaptive systems
which interact in two-way interactions with their respective social, technical as well as task work
contexts. In the dynamic interactions with their respective environments new cognitive as well as
physical structures are created which open up new potential for group interactions within the given
setting (McGrath, Arrow, & Berdahl, 2000).

Besides the influences of the major input factors, the interaction process is itself constituted of
internal dynamics. Those dynamics may first result out of the different purposes of communication
processes which groups or teams are simultaneously fulfilling. According to McGrath (1991) the
purpose of communication processes within teams can be summarised in three functions -
production, member support and group wellbeing function. Those functions parallel what Hackman
and Morris (1975, pp. 18) calls the 'summary variables' of group interaction processes that make a
difference in group effectiveness.

Teams have to simultaneously manage multiple goals which reflect their primary goal oriented as
well as social functions. This multiplicity of goals leads to the requirement of managing multiple
bundles of activities 'in particular periods of time' (McGrath, 1991, pp. 163). Therefore teams in their
task accomplishment are always involved in multithreaded sequences of interdependent interactions
which address team goals on different levels. Teams thereby should be analysed according to their
differing function - not solely according to their performance orientation - to really understand the
trajectories of actual team interaction processes (McGrath, 1991).

Even though the early I-P-O models developed by McGrath (1964, 1984) are often critiqued as quite
linear and deterministic theories (Ilgen, Hollenbeck, Johnson, & Jundt, 2005; LePine, Jackson, & Saul,
2008), already in these models the notion of feedback loops were mentioned. Those concepts
consider the effects of group interaction processes that lead to the emergence of different patterned
relationships in the standing group (McGrath, 1984). Even though, they might not have it explicitly expressed, but the models were able to conceive teams as repeated feedback loops between different types of tasks.

In a similar vein in more recent episodic team process models (Ilgen et al., 2005; LePine et al., 2008), processes are differentiated from so called emergent states. Marks et al. (2001, pp. 357) define team processes 'as members' interdependent acts that convert inputs to outcomes through cognitive, verbal, and activities directed toward organising task work to achieve collective goals’. The episodic model of team processes postulates that I-P-O relationships 'occur over a series of related cycles' (Marks et al., 2001, pp. 358). Such recurring cycles can be defined as team work episodes, in which specific goals of the team task are pursued. Through such episodes again new states in team can emerge, which influence the further structuring of upcoming episodes. Thereby team processes require interdependent interactions between team members to achieve meaningful outcomes. Marks et al. (2001) differentiate between team and task work processes, thereby integrating the notion of the social and technical system (Emery & Trist, 1969). Task work processes include the teams' interactions with tasks and technologies; whereas team work describes team members' social interactions. The combination of task and team work processes describes team processes in the pursuit of specific goals, thereby taking into account goal directed self-organising feedback loop systems as outlined by Lewin (1947b).

3.1.4 Teams as open, complex and temporally dynamic systems

According to the historical arguments developed so far teams can be conceptualised as complex, self-organising systems in which global patterns of interactions emerge from local interaction, that subsequently structure further local interactions (Arrow et al., 2000, pp. 39). System complexity can be defined according to the number and variety of regularities in the structure and behaviour of the group. Theories and research in the context of teams conceptualised as complex systems share the assumption that groups change over time according to external and internal dynamics (cf. Arrow et al., 2005). Because, groups in different phases and in respect to their context operate in different time scales or frames, such temporal changes are understood to process in a nonlinear way. The complexity of groups tends to increase over time, as the number and variety of patterned regularities in the structure and behaviour increase.

Groups can be conceptualised as open systems involved in active two-way exchanges with individuals, other groups, and higher order entities such as the social and the technical contexts (Emery & Trist, 1969). Thereby three levels of causal dynamics continuously shape the group (Arrow et al., 2000):
a) Local dynamics refer to the structuring episodes as a group constituting element. They give rise to group level or global dynamics if they get established within the group.

b) Global dynamics refer to the evolution of system-level variables emerging from and subsequently shaping local dynamics.

c) Contextual dynamics refer to the impact of features in the embedding contexts that shape and constrain the local and global dynamics of groups.

Figure 1: Research framework structural and process related enablers for partially distributed teams in a global context (adapted from Arrow et al., 2000)

Even though, that the local interactions in groups might differ according to the respective contexts, and respective task cycles, the overall or global dynamics of teams are perceived to behave according to less complex regularities. Therefore, natural groups can be studied and compared in their respective contexts by finding similarities of global patterns. Respective theories can be developed which connect contextual and process related features to the global regularities that could be discerned. Recent research on teams is more inclined to search for interaction effects between various inputs and processes, between various processes, and between inputs processes and emergent states (see Ilgen et al., 2005; LePine et al., 2008 for comprehensive literature reviews). Therefore, in the following chapters respective influence factors in the context of partially distributed
global teams will be outlined, which are perceived to have critical influence on global patterns. For the case of this thesis interaction effects of context variables, such as the geographical distribution in a demographic faultline setting (Lau & Murnighan, 1998) and the specific impact of different forms of task interdependence (Wageman, 2001), as well as media properties (Dennis, Fuller, & Valacich, 2008) on task-related information processing and processes of social categorisation (van Knippenberg et al., 2004) will be of interest. The influence of such contextual parameters on the actual task and group related interaction processes will be investigated as well as respective interaction effects.
3.2 Contextual parameters and dynamics in partially distributed global teams

In early studies on virtual team work and distributed decision making, mostly distributed teams that were only communicated via cmc were compared to collocated teams, where people communicate in a f2f setting (see Driskell, Radtke, & Salas, 2003; Powell, Piccoli, & Ives, 2004 for literature reviews). With the beginning of the new millennium and the emerging importance of field studies of virtual team work researcher recognised that those teams were seldom completely virtual, and were not solely depending on cmc (cf. Espinosa, Cummings, Wilson, & Pearce, 2003; Orlikowski, 2000, 2002). In a field study by Maznevaski and Chudoba (2000) the critical relevance of rhythmically recurring f2f meetings for the success of globally distributed team work was shown. Consequentially, virtuality more and more was measured on scale ranging from completely virtual to completely f2f interactions in teams (Gibson & Cohen, 2003; Martins, Gilson, & Maynard, 2004). The concept of hybrid teams was developed (Fiol & O’Connor, 2005), for teams, in which people are depending to a major extent on cmc, but also have the possibilities to interact f2f.

Furthermore, different dimensions of virtuality were discerned. In an early minimal consensus approach Hertel, Geister and Konradt (2005) defined virtual teams as two or more persons, who collaborate interactively across sites, organisations and time zone, and are therefore, predominantly depending on cmc. In later definitions the dimensions ranged from dependence on electronic media, temporal dispersion, geographical dispersion, cultural differences, differences in work practices (Chudoba, Wynn, Lu, & Watson-Manheim, 2005), the mobility of involved team members, as well as temporariness of team memberships (Vartiainen, 2006). Even though, that some of the studies (see for example Gibson & Gibbs, 2006; Mei, Watson-Manheim, Chudoba, & Wynn, 2006) where able to disentangle specific effects of such a complex multidimensional construct of virtuality, the diversity of the included dimensions and respective differential effects on team processes did not lead to a better understanding of involved interrelationships.

In a third phase of research on virtual teams, therefore, the multidimensional construct was more and more dismantled. Differentiated definitions helped to gain better insights into the impact of relevant contextual parameters. Hence, aspects of geographical distribution (temporal, geographical and contextual) were distinguished (Boyer O’Leary & Cummings, 2007), which are perceived to have a differential impact on team level processes. According to more recent empirical studies (Díaz, Acuña, Aedo, & Ocker, 2011; Huang & Ocker, 2006; Polzer, Crisp, Jarvenpaa, & Kim, 2006), the contextual distribution of team members across sites has critical effects on team processes. Contextual dispersions can be differentiated according to the number of involved sites, the isolation of members in specific sites, and according to the balance or imbalance of the number of people working at specific sites (Boyer O’Leary & Cummings, 2007). In respect of a further differentiation of virtual team definitions, for partially distributed global teams, the balanced distribution across two
sites is a key contextual variable with respect to its differential influence on subgroup dynamics in virtual teams (cf. Huang & Ocker, 2006; Polzer et al., 2006; Webster & Wong, 2008). Furthermore, the aspect of more complex innovative tasks, which require the integration of cultural differences will be taken into account for the definition of global teams (Berg, 2006; Janssens & Brett, 2006). Additionally, in line with the arguments on the degree of electronic dependence (Gibson & Cohen, 2003; Martins et al., 2004), the teams have to be defined by the degree of use and characteristics of their communication tools. In the distributed context, the idea of a team has to be seen in a more socio-psychological perspective (cf. Guzzo & Shea, 1992). A team is only functioning as an entity of an interdependently working unit, when it is perceived by its members as well as relevant others in the organisational context as such an entity. As argued earlier (Ryser, Schulze, et al., 2011), the aspect of interdependent task work becomes a defining characteristic of distributed team work, as only in interdependent structures the notion of a shared team identity or orientation emerges.

In a minimal consensus perspective (Hertel et al., 2005) partially distributed global teams, are defined as teams ...

- involving members from different cultural backgrounds,
- which interdependently collaborate on tasks with global relevance,
- in a nationally distributed context with homogenous subgroup size dispersed across two sites,
- therefore, depending to some degree on computer supported communication media.

The defining contextual factors of partially distributed global teams, such as the objective dimensions of geographical dispersion and related dependence on cmc or cultural diversity, structural task interdependence are conceptualised as contextual boundary conditions (Emery & Trist, 1969). They are discussed in terms of having differentiated influence on global and respective local dynamics in team performance episodes (Arrow et al., 2005; Marks et al., 2001). The context of partially distributed teams and its processes has to be viewed in the concept of fit as outlined by McGrath (1984); respective boundaries are established and maintained through 'the actions, behaviours and beliefs' of the people involved in a specific context (Watson-Manheim, Chudoba, & Crowston, 2012, pp. 34). Thereby, the dynamic effects of contextual parameters depend on the perception of team members as well as occurring processes on the social as well as the task-related level (Ilgen et al., 2005; Marks et al., 2001). In the following paragraphs a review of respective research findings is presented, to illustrate such dynamic interactions with different defining contextual factors of
globally distributed teams. First of all, the defining characteristics will be introduced in the subsequent chapters.

3.2.1 Teams working on tasks with global relevance

Since the early strategic and theoretical conceptualisation of the transnational organisation as a new form of globally operating, de-centralised unit by Ghosal and Bartlett (1989), the role of global teams has been mentioned to be important for integrating diverse knowledge in global processes. Even if those strategic and managerial claims have to be viewed in the respective historic-political setting with its own ideological underpinnings (Irani, Vertesi, Dourish, Philip, & Grinter, 2010), distributed global teams which enable diverse forms of innovation (social, organisational, process, product or service-related) have to be considered as a prevalent reality in today's multinational organisations.

On the team level several forms of organising globally distributed, innovation work have been discerned (Grinner, Herbsleb, & Perry, 1999; Ryser, Schulze, et al., 2011), which do not all allow for team work and integrated decision making. The research interest here, however, is to study the conditions under which such an integration of the required divergent and convergent processes are enabled.

Consequently, in the global team literature (Berg, 2006; Janssens & Brett, 2006; Maynard, Mathieu, Rapp, & Gilson, 2012; Maznevski & Chudoba, 2000) the requirements of tasks which have the goal of integrating different global perspectives was conceptualised as a defining characteristic. In further developments of the early definition of global and virtual teams, Maznevski and Chudoba (2000, pp. 473) introduced the aspect of global teams being responsible 'for making and implementing decisions important to the organisation's global strategy'. In reference to Ghosal and Bartlett (1989), the task of global and virtual teams was seen in integrating local perspectives for developing strategic decisions on a global level. Therefore, globally dispersed managers were required to interdependently work towards a comprehensive global strategy, which had to be implemented again in the respective local settings.

The complexity of tasks can be described, according to Daft and Macintosh (1981), with the help of a continuum ranging from routine to more complex non-routine tasks originally developed by Perrow (1967, cit. in Daft & Macintosh, 1981). But task complexity has to be further differentiated between the differing dimensions of task variety and task analysability. Task analysability refers to the underlying problem structure of to be achieved tasks. We can differentiate between analysable tasks with only one correct response, so-called intellective tasks and tasks where there is a certain amount of equivocality regarding the solution space. Equivocality is understood in the sense, that there are multiple interpretations or meanings in regard to projected objectives. Thus, the finding of an
optimal solution requires a social negotiation of the best solution to the problem at hand. Whereas in the case of intellective tasks one may speak of informational uncertainty as the task just requires the search for the required information to solve the task. To define task complexity, furthermore, a characteristic defining the possibilities for varieties in the process of work seems important. Therefore, Daft and Macintosh (1981, pp. 208) introduced the notion of variety defined as the ‘frequency of unexpected and novel events that occur in the conversion process’. Those dimensions of task complexity influence information processing contingencies in differing ways and influence an optimal choice of group work technologies (see chapter 2.2.4).

Janssen and Brett (2006, pp. 125) further extended this definition of the tasks of global teams towards what they called ‘creative realism’. In their concept innovative tasks of global teams do require to extract relevant information bound to the respective cultural context of the involved team members to develop creative ideas. Furthermore, to enable realistic ideas which can be implemented in comprehensive decision making has to be stimulated. Therefore, two key tasks are discerned:

- The extraction of diverse information embedded in the culturally diverse contexts of the involved team members
- Comprehensive decision making, which allows for the integration of the diverse perspectives on globally relevant strategic goals

The key tasks for global teams involve different and sometimes contradictive requirements for task work. Information extraction should be enabled by processes of divergent thinking, overcoming biases and fallacies, such as for example group think (Janis, 1982). So teams are required to maximise on their diverse inputs, by not falling into the fallacy of converging too fast on their common knowledge resources also called the common knowledge bias in groups (Gigone & Hasti, 1993, cit. in Janssen & Brett, 2006). According to Stasser, Vaughan and Stewart (2000), such effects can be restrained by distributing expertise roles. The requirements of distributed information extraction are somehow at odds with the requirements of making decisions for problems in a context of global market competition. The decision making task requires convergent processes to integrate the diverse perspectives available in the global context. Janssen and Brett (2006) conceptualised micro-political processes as being of critical importance for the success of such tasks. Thereby, in the context of global teams, the respective power relationships between involved sites have to be taken into account.

Without directly referring to, the contradictory processes mentioned by Janssens and Brett (2006) can be compared to the exploration vs. exploitation dilemma as originally stated by March (1991).
The stated dilemma for productivity on an organisational level focuses more on the aspect of implementation and reproduction of developed ideas is farther reaching than simple decision making. Even though, the concepts have some resemblance in the process of divergent and convergent thinking. In the productivity dilemma as originally stated by March (1991), the convergent processes of exploitation and implementation imply formalised organisational structures for effectiveness. These formalised structures are seen as standing at odds with the requirements for exploration and the development of creative ideas and thereby pose a serious dilemma for organisations on different levels (Anderson, De Dreu, & Nijstad, 2004). The concept for integrating these paradoxical processes has been further developed to think about the requirements on the level of team innovation processes by Bledow, Frese, Anderson, Erez and Farr (2009). The organisational and the temporal structuring of respective episodes of information extraction and the requirements for integrative decision making (Janssens & Brett, 2006), which allow for further implementation in exploitative processes are of special interest for this thesis.

3.2.2 Understanding of cultural heterogeneity in globalised work contexts

According to Bolten (2008) there seems to be a shift from coherence-based conceptualisation of culture in the early 70ies of the last century towards cohesion-based conceptualisations of cultural diversity. Coherence-based concepts tend to view cultures as homogenous entities which are integrated by shared beliefs, values, attitudes of its members (Rathje, 2006). The intercultural interaction thereby is seen as an intersection between such homogenous entities by the creation of a third space as kind of a new cultural field (Casnmir, 1999). Since the second wave of globalisation following the global distribution of the world wide web and further reaching global mobility of the work force, the conceptualisation of cultures as homogenous entities with values as their core defining elements seems more and more outdated (cf. Morris, 2014). Cultural identities are constituted out of complex affiliation to a myriad of different groups. Culture can thereby not be seen as unique affiliation to one specific group, it rather has to take into account this multitude of affiliations which are relevant for the cultural identity of a person in a specific context. Experiments with bi-cultural Chinese subjects indicate (Hong & Chiu, 2001; Hong, Morris, Chiu, & Benet-Martinez, 2000; Mok & Morris, 2010, 2011), that people are able to switch their cultural orientations according to situational demands.

Nowadays, to reflect interculturality especially in a global work force it seems important to conceptualise diversity via principles of cohesion (cf. Bolten, 2008). Cohesion principles are more prone to reflect dynamic interactions between persons and their multiple possibilities for cultural identification in specific situations. In models which conceptualize diversity on cohesion principles
(cf. Kitayama, 2002), culture is defined as orienting knowledge or meaning systems, integrating attitudes, beliefs and behavioural orientations which are effective in a specific interactional context. Such shared meaning systems can be created through continuous interactions in episodic processes and through emerging representational structures between people from differing cultural backgrounds (cf. Kashima, 2004). Dynamic processes of cultural change thereby seem to be more frequently occurring than could be assumed by the former models of cultural diversity focusing on differences in internally coherent systems mostly conceptualised on the level of nation states (cf. Hofstede, 2001). In a dynamic cohesion-based perspective (Chao & Moon, 2005), culture on the level of individuals can be conceptualised as mosaics of different possible ties of connecting value orientations, which are perceived as salient in specific interactional contexts. Possibilities for the individual orientation are given through more classical demographic characteristics, such as ethnicity or nationality, but also gender, age or functional diversity are possible orienting ties, which can get salient in specific situations. Furthermore, geographical and regional influences as well as affiliative ties to specific groups influence behaviours in intercultural interactions.

According to van Knippenberg, de Dreu and Homan (2004, pp. 1008) diversity refers to any characteristic or attribute ‘that may lead to the perception that another person is different from self’. In a work context, often social category diversity is differentiated from informational or functional diversity. Social category diversity involves differences in readily observable attributes, such as ethnicity or age; whereas functional diversity which involves differences in less visible task-related perspectives grounded for example in different educational backgrounds (Jehn, Northcraft, & Neale, 1999). Moreover, in some studies (Chidambaram & Carte, 2005; Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002), surface diversity is differentiated from deep-level diversity. Surface level diversity is defined as readily observable characteristics ‘that are typically reflected in physical features’ (Harrison et al., 1998, pp 97) as for example age, ethnicity, sex etc. Deep-level diversity characteristics reflect differences between attitudes, values and beliefs as well as behavioural practices which are grounded in socialisation and interaction in specific cultural communities.

Besides the more recent tendencies to study diversity on different levels of abstraction (cf. Erez & Gati, 2004; Fischer, 2009) and to focus on an understanding of diversity, which accounts for complex cultural orientations on the individual level (cf. Bolten, 2008; Chao & Moon, 2005), research focusses more and more on the level of work groups and teams. Work group diversity can be defined according to van Knippenberg and Schippers (2007, pp. 519) as the characteristic of a social grouping ‘that reflects the degree to which there are objective or subjective differences between people within the group’. This definition of work group diversity reflects the difficulty to account for objective differences between people in a team. Work group diversity in the sense of a more
cohesion-based understanding of intercultural interactions (cf. Bolten, 2008; Rathje, 2006), can be seen as an emergent property of the perceptions of similarities and differences within the standing group (McGrath, 1984). Perceptions of diversity or so-called subjective diversity (van Dick, van Knippenberg, Hägele, Guillaume, & Brodbeck, 2008) or perceived diversity (see Shemla, Meyer, Greer, & Jehn, 2014 for a recent review) might be related to objective differences, but also might be influenced by the social construction of difference in team work interaction.

In their review on perceived diversity, Shemla et al. (2014) distinguish three types of subjectively perceived diversity:

1. Perceived self-to-team dissimilarity from an individual perspective
2. Perceived subgroup splits in teams
3. Perceived general team level heterogeneity on specific characteristics

This contribution will focus on the effects of the perceived subgroup formation in partially distributed global teams, and will include aspects of general perceptions of diversity in the teams in relation to the specific contextual distribution (Boyer O’Leary & Cummings, 2007). In connection to the studies on subjective (van Dick et al., 2008) and perceived diversity (Shemla et al., 2014), the effects of subjectively perceived diversity are conceptualised as more directly influencing occurring team dynamics compared to more abstract, objective dimensions.

3.2.3 **Contextual dispersion in partially distributed teams**

Partially distributed teams can be characterised as teams working together in a context of geographical dispersion with two or more collocated subgroups involved (cf. Cheshin, Kim, Bos Nathan, Ning, & Olson, 2013; Metiu, 2006; Ocker, Huang, Benbunan-Fich, & Hiltz, 2009; Plotnick, Hiltz, & Ocker, 2012). On the more objective side of structural aspects, geographical dispersion implies collaboration across spatial temporal as well as contextual boundaries (Boyer O’Leary & Cummings, 2007). Spatial distance accounts for the spatial dispersion of different team members. The temporal dimension of dispersion includes both dimensions of transcending time zones in distributed collaboration as well as differences in practices of formal working hours, which might be caused by different working shifts. The aspect of contextual dispersion involves the amount of sites involved in dispersed collaboration as well as the member balance between the sites. This aspect of dispersion can furthermore be differentiated between the isolation of single members at specific locations and the balance or imbalance between involved members at different sites. As the aspect
of contextual dispersion seems to be related to critical social processes in partially distributed teams, those effects will be discussed in more detail in the following paragraphs.

Contextual dispersion, defined as the 'arrangement of members across sites', which are independent of 'the spatial and temporal distances among them' (Boyer O'Leary & Cummings, 2007, pp. 439), complicates the dynamic effects of objective boundaries on collaborative work in partially distributed teams. Partially distributed teams can be described as teams, which involve two sites, in which a certain numerical balance between the involved members hinders the isolation of members at a specific site.

Studies on the topic of partially distributed teams indicate (Díaz et al., 2011; Mattarelli & Gupta, 2009; Metiu, 2006; O'Leary & Mortensen, 2010; Ocker et al., 2009; Polzer et al., 2006), that a contextual dispersion into balanced subgroups seems to effect individual and group categorisation processes and can result in more frequent conflicts and coordination problems especially in dispersed settings where two subgroups are interacting across distance. In such partially distributed team settings demographic characteristics, such as nationality, ethnicity, and organisational belonging are aligned to the geographical distribution of team members. Such divisional lines, which hypothetically 'may split groups into subgroups based on one or more attributes' are defined as faultlines by Lau and Murnighan (2005, pp. 645). Active faultlines are differentiated from the passive or dormant faultlines (Zanutto, Bezrukova, & Jehn, 2010). Dormant faultlines are seen as a potential for forming subgroups along delineated diversity characteristics. Similar to the concept of perceived diversity (Shemla et al., 2014), active faultlines are subjectively salient dividing lines by the group members involved. Because partially distributed teams are contextually dispersed in a way that demographic characteristics of locally defined subgroups are aligned, the potentiality of a faultline to become salient or active in a specific group setting is expected to be very high. Faultline strength measures this probability of aligning the subgroups along dividing diversity characteristics (Thatcher, Jehn, & Zanutto, 2003). Furthermore, active faultline measures, which directly assess the perception of dividing subgroup structures can be differentiated (see Meyer & Glenz, 2013 for a comprehensive review of faultline assessment methods).

The activation of a faultline is dependent on contextual factors, such as the structuring of group goals and tasks as well as process related factors, like the actually occurring team processes between members of demographically defined subgroups (cf. Rico et al., 2012). On the other hand, such task work-related processes might be negatively influenced by categorisation and identification processes on group and intergroup level (van Knippenberg et al., 2004). The perception of faultlines in partially distributed teams is influenced by the actual forces of identification of team members towards their local, culturally entrenched subgroups as well as the spatially transcending global teams as an acting
group (McGrath, 1984). The effects of a balanced contextual dispersion on social categorisation processes in teams will be further discussed in chapter 3.3.2.

### 3.3 Structural interdependence as enabler in partially distributed teams

Interdependence can be conceptualised as the primary boundary condition (Emery & Trist, 1969) for complex, open systems such as teams. Interdependence in this sense refers to mechanisms of social systems for coupling with environmental requirements, as well as for internal coupling and orchestration or coordination of group processes. Johnson and Johnson (2005) stated that boundary interdependence is the central form of interdependence, which defines the possibility to react to discontinuities in the context. The contingencies for external coupling have already been described in the previous chapters on contextual parameters, in this chapter we will focus on the influence of internal interdependence mechanism.

Hence, the focus is on interdependence, which influences internal dynamics of task work as well social processes. The type of contact or interdependence that leads to a change in people’s attitudes towards each other and the task work processes at hand are important. Already Allport (1954, pp. 264) mentioned the importance of intergroup contact for changing attitudes towards persons from different cultural contexts. He thereby stated that: ‘*Only the type of contact that leads people to do things together is likely to result in changed attitudes*’. Furthermore, he proposed that change of attitude only occurs when certain conditions are met that allow people to interdependently do things together. In Allport’s (1954) developments of the contact hypothesis the following conditions for structured, interdependent interaction were proposed:

- Equal status between participants
- Opportunities for personal interaction
- Co-operative interdependence
- Supportive norms

Allport’s (1954) notion of doing things together involves two central dimensions of cooperative contact: interacting together in the (work) process or sharing a common fate in a context of interdependent structures. In a more recent definition of interdependence (Wageman, 2001), such structural forms of interdependence are distinguished from actually occurring behavioural interdependence in the workflow process. Structural interdependences refer to features of the design of work, which require a group of people to exchange resources. Behavioural interdependence as defined by Wageman (2001) constitutes the amount of task-related interdependences covered by team members in the process of task work. Regarding different forms
of structural interdependence it is important to distinguish between task and goal or outcome interdependence (De Dreu, 2007).

### 3.3.1 Structural interdependences regarding goals

In Deutsch's (1949) theory of social interdependence positive and negative interdependences are conceived as two opposite poles of a continuum. The perception of interdependence structures is defined by the perception of the social situation as a whole in the sense of Lewin's (1947a, 1952) definition a social field of action. If individuals perceive that they can reach their goals only if others with whom they are linked reach theirs, we can speak of positive interdependence. In contrast, in competitive situations people perceive that their goals only can be reached if other's fail to reach theirs. The theory states that when people in specific situations perceive their goals to be interdependent, their actions will be more cooperative. This is furthered by the perception of positive dependence of one own and other's goal achievements. Social interdependence theory (Deutsch, 1949), claims a direct influence of structural forms of interdependences on behavioural interdependences in the process of working towards interdependent goals. In an integrative perspective the definition of outcome interdependence provided by Wageman (2001) integrates all characteristics that define the degree, to which the consequences of the work are contingent on collective team performance. It thereby includes goal interdependence defined as the contingent measurement of collective output as well as reward interdependence implying team output contingent gratification.

The theory of social interdependence has been tested in a series of experiments (see Johnson & Johnson, 2005 for an extensive review). It could be shown that cooperative efforts lead to more elaborate communications, more extensive and attentive listening, better acceptance of differing ideas and solutions brought up by significant others, more helping and supporting behaviours, and better development of trusting relationships. Cooperative behaviours in the process finally result in a higher degree of productivity in teams under cooperative goal interdependence. One major critique of the studies in the field of social interdependence theory is that the central assumption of the theory has not been directly challenged by empirical path analysis (Johnson & Johnson, 2005). Therefore, the central assumption of the direct influence of structural forms of interdependences on cooperative action during task work and more productive team outcomes has not been empirically tested so far.

Considerable debate prevails (cf. Wageman & Gordon, 2005) about the direct influence of cooperative goal or outcome interdependence on behavioural interdependence in the process of task execution. According to studies by Wageman and Baker (1997) and Wageman (1995) situations of negative outcome interdependence directly undermine cooperative behaviours, but cooperative
outcome interdependences do not directly influence behavioural interdependences in the process of task work. In a similar vein a more recent study of faultline teams (Rico et al., 2012) could show that only the combination of goal and task interdependence lead to higher performance on more complex tasks. According to those studies it rather is the combination of cooperative outcome interdependence with structural task interdependence that influences the cooperative behaviours in the work process. Thereby cooperative or positive outcome interdependence can be seen as a preliminary but not sufficient condition for cooperative behaviours to occur; whereas structural task interdependence is seen as direct predictor of cooperative behaviours.

3.3.2 Structural task interdependence

Task interdependence defines the inputs of work and sets contingencies regarding the requirements to work interdependently on the task. Wageman (2001) proposes to differentiate between four principles for defining structural task interdependences:

1) Principles of task definition, specification or allocation to the group vs. to individuals
2) Rules regarding the instructions for interdependent work in the process descriptions
3) Traits of task technologies (e.g. allowing for synchronous, intensive interdependences in f2f-settings, or allowing for asynchronous individual work)
4) Principles of resource distribution (e.g. competences, information, materials) required for task accomplishment

According to Wageman (2001), it seems important to conceive structural task interdependences not as solely predicted by for example resource distributions, but rather as an interaction between the four stated principles at work in a specific context. If the competences for a task are clearly distributed across team members, the task can be defined in a way that it will be perceived mainly as individual work. For example, if a construction is subdivided in subtasks where hypothetically one individual is responsible for, the task will mainly be perceived as individual work and not as team work. In a similar vein a task, which can be conceived as individual work according to the competences of the individual cannot be achieved individually, because the task technology requires two persons for its operation. Therefore, the four principles of structural task interdependence always have to be analysed according to their interdependent relationships in a specific work context.

Regarding the four dimensions of task interdependence the question arises, if task interdependence can be seen as a continuum, which differs according to the degrees of required interdependences in
the four dimensions mentioned above. Or, if task interdependence rather than being a question of degrees should be understood as discrete forms of interdependence with differing qualities. Here again the differentiation between structural forms of task interdependences and behavioural interdependences in the process of task execution might help. According to Wageman, Gardner and Mortensen (2012) the principles of structural task interdependence might vary on a continuum: Ranging from tasks, which are allocated to individuals, require only individual competences and do not imply coordination caused by task-technology; to tasks, which require a very high degree of interdependence because of the distribution of competences in the team, as well as the used work technologies.

3.3.3 Media properties and information processing in teams

For the identification of media properties, which influence communication processes so-called media trait theories can be taken into account (cf. Döring, 1997; Watson-Manheim & Bélanger, 2007). Those theories of media choice assume that media possess objective and stable characteristics that pre-condition communication. Media richness theory (Daft & Lengel, 1986) can be viewed as one of the first trait theories of media choice. To process equivocality, an exchange of differing perspectives on a topic to resolve potential conflicts of interpretation and enact a shared understanding that directs future actions is required (Daft & Weick, 1984). According to Daft and Lengel (1987, pp. 358) the processing of equivocal information is facilitated by rich communication media. Besides the confusion of defining richness in the same time as information characteristic (Daft & Lengel, 1986; Daft & Weick, 1984) and as a media characteristic (Trevino, Lengel, & Daft, 1987), the term will here be generally defined as ‘the capacity to facilitate shared meaning’ and is characterised by four criteria or traits of media channel capacity:

1. Richness of a media is heightened through the capacity of direct and immediate feedback in communications. Direct feedback allows communicative actors to directly ask questions of understanding and make corrections. This enables faster adjustments of meanings and interpretations.

2. The possibilities to rely on multiple cues of a communication media - different sensorial channels to process communication - facilitates checking of transmitted information via verbal communication by additional non-verbal or sensorial cues.

3. Language variety defines the capacity of the symbol system used to carry differing views and perspectives. For example the illustration of analogies or metaphors allow for a broader range of possible interpretations than numbers.
4. Furthermore, media may be differentiated according to the personal focus and capacity to transmit emotional contents and feelings.

All those traits of rich media should allow for a faster processing of equivocal and contextually rich informational contents. Communication environments can be classified according to their ability to process equivocal information according to the processing capacity defined by the mentioned richness criteria. In the original ranking of media by Daft et al. (1987) the f2f setting is followed by telephone, text-based media and unaddressed formal documents.

There have been two major extensions of the so-called media trait theories. First of all the theory has been extended by the proposed circumplex model of group tasks by McGrath (1984), towards the task-media fit hypothesis. According to the task-media fit hypothesis group tasks can be ordered in a circumplex model, which is defined on the horizontal axis by the amount of cognitive versus behavioural performance, and on the vertical axis by the amount and form of interdependence required among group members. Tasks are grouped in the following order regarding the required transmission of equivocal information: generating tasks, choice of a correct answer (intellective tasks), choice of a preferred answer (non-intellective tasks involving subjective preferences), the negotiation of conflicts (requiring the resolution of differing viewpoints) (Hollingshead, McGrath, & O'Connor, 1993).

In empirical studies the assumptions of the media task fit hypothesis so far could only be affirmed for non-intellective and negotiation tasks, for intellective as well as generation tasks. The ordering of media according to the richness criteria could not be supported (Mennecke, 2000; Valacich, Mennecke, Wachter, & Wheeler, 1994). An explanation for those findings is that there is ambiguity or equivocality in intellective tasks or simple idea generation tasks. This ambiguity resides not on the level of task solution, but in the social organisation of task work. Straus and McGrath (1994) study could show that such ambiguities might be even higher in richer communication settings such as f2f meetings. Through the richer channel in such settings the role coordination in brainstorming tasks gets more interdependent because people have to coordinate their turn-taking. The interaction in this experimental setting resulted in comparable outcomes between f2f and computer-mediated settings and preference for f2f of the involved subjects. Similarly in the studies by Mennecke et al. (2000; 1994), unequal information distribution between the dyads in the intellective task condition involved a higher degree of equivocality regarding the coordination of task roles of the members in the dyads. The higher amount of equivocality led the teams start their task with a phase of problem solving concerning the required role distribution.

The insight that every task might have some amount of equivocality led to the second major change in the vein of media trait theories. It was assumed the matching on the task level might be too broad
and a matching of media capabilities or traits on the level of communication processes is more appropriate (Dennis et al., 2008; Dennis & Valacich, 1999). In the media synchronicity theory it is assumed that every task to differing amounts involves the fundamental communication processes of conveyance and convergence. Conveyance processes are defined as the ‘transmission of a diversity of new information [...] to enable the receiver to create and revise a mental model of the situation’ (Dennis et al., 2008, pp. 580). Conveyance processes can be supported by media that allow a parallel transmission of information, and which leave time for encoding the message (‘rehearsability’) and decoding the message (‘reprocessability’). Convergence processes involve the discussion of ‘preprocessed information about each individual’s interpretation of a situation’. The objective of such processes is to develop a shared understanding of a given situation. Such a development can be supported by higher transmission velocity, which allows for immediate feedback and repairs in communication situations, as well as a variety of symbol sets for example by using voice, tone and gestures in f2f conversations. For convergence processes media traits or characteristics should enable synchronicity - a state of simultaneous and synchronous coordination of action.

First of all, it seems important to differentiate between the actual function the team is performing, whether it is task-related or related towards the relationships within the group (cf. McGrath, 1991). On each level requirements regarding the traits of the channel may differ. The multi-threadedness of communication in different functions in a specific situation of a standing group might involve higher requirements regarding media traits. It is assumed here that different team performance episodes (Marks et al., 2001), which enable the function of information extraction and comprehensive decision making (Janssen and Brett, 2006) through divergent and convergent communication processes require differential media traits in relation to synchronicity (Dennis et al., 2008). Furthermore, the established work practices and qualities of the interaction process of a particular team might have an influence on the perception of the function of specific media traits (Carlson & Zmud, 1999). Thereby the perception of actual traits is influenced by the actual norms and rules operating in a specific team episode (Orlikowski, 2000). It seems important to have a look at the temporal structuring of media use on the level of communication processes in respective team performance episodes to understand the requirements regarding richness and synchronicity.
3.3.4 Behavioural interdependence in the process of task execution

According to Wageman (2001) behavioural interdependences seem to function as step level function: When a certain threshold of interdependences of task is structurally given, work groups tend to show team like behavioural interdependences. Therefore, on the level of behavioural interdependences, in a contingency perspective, typologies of interdependence structures have been proposed (cf. Thompson, 1967). To understand interdependences in organisations task interdependence are distinguished as qualitatively distinct forms of interdependence. According to the contingency based theory behavioural forms of task interdependences are contingent on the task environment, external and internal coupling requirements regarding the task at hand. Such requirements largely are dependent on the complexity of the team task at hand (cf. Bell & Kozlowski, 2002). In his book on organisations in action Thompson (1967) set the ground for the understanding of task interdependence by postulating three differing types of interdependences in organisations. Based on explorative insights in differing cases of US organisations he developed a contingency view of task interdependences, which set the requirements of the degree and frequency of communication between the members of organisational units. Contingencies of task interdependences in turn define the rational for the most effective form of coordination. To him in every organisation at least one type of task interdependence was required to survive. He saw the occurrence of multiple forms of interdependence between subunits in organisations as a measure of organisational complexity. The following forms of behavioural interdependence were proposed:

- In pooled interdependence settings units in organisations do not depend on the effort of other involved units. Involved units share the same fate as members of the larger collective in Thompson's (1967) empirical examples mostly organisational sites. This form of interdependence mainly can be characterised as the complete absence of any task-related interdependence between units of work. This mode of interdependence is defined by independent work of persons or organisational units (Wageman, 2001).
- Another form of interdependence identified was a sequential temporal succession of the outputs of single tasks of specific units. The type of sequential work interdependence as defined by Thompson (1967) does not require any higher order information processing capabilities between the units. Simply put, in sequential types of interdependence, the outputs for a subsequent unit have to be finalised and will not be changed anymore by the former unit. It might be questionable, if such unilateral forms of interdependence can be accounted for task-related team interaction processes, but in Fordist and Taylorist production system such forms or interdependence can be easily imagined. According to a
field study by Ballard and Seibold (2004) this type can be coordinated by scheduling and temporal planning.

- In the reciprocal form of interdependence the outputs of each unit result in inputs for all other units, thereby the coordination requires an on-going and less formal communication between the units to ascertain effectiveness. This form of coordination, which is called coordination by mutual adjustment, can also be applied to forms of team work were mutual adjustments are required between team members.

To refine behavioural interdependence flows of group work van de Ven, Delbecq and König (1976) proposed a further type of so-called team or intensive interdependence. The difference between reciprocal and intensive interdependence is seen in requirements for synchronous problem solving activities. Intensive interdependence thereby requires team members to simultaneously diagnose and collaborate to solve complex problems.

There is criticism (cf. Wageman, 2001) to the transfer of interdependence principles form the level of organisational units to teams. For example, the first of the two interdependence forms described by Thompson (1967) cannot be taken into account for describing interdependent team work, as pooled and sequential interdependences do not require a group to collectively perform on a task (cf. Wageman, 2001). Even if the fourth form of intensive interdependence (van de Ven et al., 1976) is added to the proposed forms of interdependences, the definition and differentiation of team level interdependences stay minimal. To further differentiate team interaction modes for the definition of required behavioural interdependences. Thus, it is proposed here to look at definitions of coordinative and cooperative modes in collaborative work for a better understanding of interdependences in the task work process on the team level.

### 3.3.5 Contingencies of behavioural interdependence on modes of collaboration

Coordination can be defined as the actions being undertaken to orchestrate or manage interdependent tasks and subtask of a bigger activity (Espinosa, Lerch, & Kraut, 2002). March and Simon's (1958) differentiation between coordination by programming and coordination by feedback indicates a task-based contingency. Tasks with lower degrees of complexity or equivocality can be managed by rather impersonal means, such as formalising plans, schedules, procedures, etc., whereas tasks with higher degrees of complexity require communication for interpersonal adjustment. In a further differentiation van de Ven, Delbecq and König (1976) distinguished between three fundamental modes of coordination, which constitute respective boundary conditions for task complexity and interdependence structures. The impersonal coordination mode is operated by the
formalisation of plans, schedules, rules, norms as well as roles and tasks. In this mode task
interdependence is not required. The coordination of activities can be managed by impersonal
specification of process standards (cf. Ballard & Seibold, 2004). If such specified standards are
codified and established the verbal communication requirements can be held at a minimum level.

Modes of coordination, which require communication for feedback and adjustment, can be
differentiated as interpersonal and group modes (van de Ven et al., 1976). In the interpersonal mode
role occupants communicate, to adjust to occurring varieties in the process of task accomplishment.
In the interpersonal mode interdependences are managed mostly by vertical, but also by horizontal
channels of communication. In the group mode, synchronisation on a more direct horizontal level is
required to cope with planned as well as unplanned task-related events. Coordination in the group
mode can be structured both by scheduled and unscheduled meetings.

In more recent literature (Espinosa et al., 2002) on coordination the above mentioned modes of
explicit coordination are differentiated from more implicit modes. Implicit coordination modes
thereby emerge from shared knowledge structures developed in team interaction, which enable an
orchestration of tasks by 'unspoken assumptions' or behavioural scripts. The fundament of implicit
coordination modes are shared team cognitions regarding expected task processes and outcomes.
Teams are coordinated as long as cognitions or behavioural scripts of tasks are implicitly or explicitly
shared. When the goals or means to achieve them are questioned, teams function in a mode of
reflexive communication or cooperation. According to Engeström (1992) degrees of reflexive cycles
in activity or group work systems can be differentiated according to the questioning of goals and
mediating means for goal achievement. In the mode of cooperation instead of fulfilling scripted roles,
participants focus on a shared problem, a common object. Thereby, they try to find a mutually
acceptable way by negotiating a solution or goal space for further coordinated action. Cooperation is
required when participants go beyond constraints of a given behavioural script (see Wehner, Clases,
& Bachmann, 2000 for a similar definition), without questioning the goal itself. In cycles of reflexive
communication or phases of co-construction the goals and behavioural scripts are questioned
simultaneously. Thereby actors are reflexively re-organising their own structures as well as task-
related processes in relation to desirable goal states. In reflexive cycles of co-construction they are
re-adjusting whole activity systems, which allow for coordinated team interaction. Teams are thereby
enabled to cope with task equivocality taking both goals and means into account. Communication
processes with differing degrees of equivocality reduction define the respective modes of
cooperation and coordination.

According to Wageman (2001) the appropriateness of different levels of interdependences and
respective modes for interaction can not only be attributed to characteristics of the task. It is
important to include further contextual factors such as technology, culture and the characteristics of
the involved individuals. Therefore, to study the efficacy of different forms of interdependence one should take into account the broader context and the respective contextual or boundary interdependences at work in specific work settings (cf. Johnson & Johnson, 2005).
3.4 Dynamics in partially distributed global teams

Groups are seen as complex, self-organising systems insofar global patterns of interactions emerge from local interactions, that subsequently structure further local interactions (Arrow et al., 2000). In the following, theoretical concepts as well as respective empirical results mostly from field studies will be presented, which account for a complex systems approach.

3.4.1 Global patterns of task work processes in teams

To create an understanding of local interactions, a theoretical model will be presented, which allows for the conceptualisation of team performance episodes (Marks et al., 2001). To come up with an understanding of global patterns and to provide an understanding of theoretical concepts of punctuated equilibria, the a referential qualitative study on the dynamics of adhoc or task force teams by Gersick (1983, 1988, 1989) will be presented in detail. Further empirical studies will highlight the importance of social entrainment and the influence of unexpected, event driven dynamics for influencing reflexive team learning processes. Thereby, the question will be raised if the so-called reflective phases in teams are only attributed to specific unexpected events or if reflective episodes are stretched during phases of adaptive team learning (cf. Engeström, 1992; Wehner et al., 2000).

3.4.1.1 An episodic team process model for an understanding of global dynamics in teams

Marks et al. (2001) conceptualised task cycles as episodes. Episodes constitute the overarching rhythm of task performance. According to an earlier definition by Mathieu and Botton (1992, cit. in Mathieu et al., 2001, pp. 359) 'episodes are distinguishable periods of time over which performance accrues and feedback is available'. The structure and duration is influenced by the complexity and contingent interdependence requirements in respective task work episodes. In their model, episodes related to direct goal accomplishment are discerned from transition episodes, in which a new task work orientation is enacted. The cycle frequency and length of alternation between action and transition episodes (compare to Figure 2) is expected to depend on contextual factors, for instance goal setting and complexity, environmental factors, such as set deadlines, as well as established expertise structures and norms regarding leadership and collaboration within the organisation. Action episodes include time periods, which involve interaction processes of goal accomplishment.
Marks et al. (2001) differentiate four team interaction processes that most frequently are associated and occur during action phases: monitoring, progress towards goals, systems monitoring, team monitoring as well as coordination activities. Similar to the process of planned action described by Lewin (1947b) the goal monitoring processes in Marks et al.'s (2001, pp. 366) taxonomy are understood as self-regulating team level processes, which alert teams 'when performance gaps emerge'. Such team level processes contain team member statements about work progress and information about the implementation of the task strategy, as well as suggestions for improvement. As a team level process, it is conceptualised as the annexation of such single member contributions within a goal-oriented monitoring episode. In a similar understanding, the monitoring of the system in the external environment as well as internal system (such as resources, the monitoring and feedback loops regarding task work) is constituted of communicative annexations of individual communicative acts. The orchestrating process of coordination, timing and sequencing of differing team activities is related to team level episodic interactions required to align team member contributions with goal accomplishment.

Transition phase episodes, in contrast to action phases, focus on evaluation and envisioning or planning activities and include processes, for instance mission analysis, goal specification, strategy definition and planning. Transition episodes are constituted out of the evaluation of two time foci:
evaluation of past achievements as well as envisioning of future improvements and goals. Mission analysis episodes tend to occur during time set aside for analysis, evaluation and envisioning of future direction. Goal specification episodes refer to the identification and prioritisation of goals for mission accomplishment. Strategy formulation and planning include deliberate planning in specific space time settings, as well as contingency planning and reactive strategy adjustment, which involve the development of alternative courses of action for mission accomplishment. Unexpected events during action phases act as triggers for contingency planning and strategic adjustment (see further elaborations in subchapter 3.4.1.5). Thereby 'reactive strategy adjustment is the alteration of existing strategy or plans in response to unanticipated changes in the performance environment and/or performance feedback' (Marks et al., 2001, pp. 366). It refers to the unexpected punctuated shifts. Such episodes can be seen as phases requiring co-operation in the sense of re- or co-constructing shared understandings, structures and processes for enabling further interaction, which are outside the routines of the habitualised action episodes (cf. Wehner et al., 2000). Therefore, it seems conceptually important to distinguish transition episodes, which are triggered by unexpected changes in the environment or dynamics within the teams, and phases which are deliberately planned, as the consequences for team work might differ.

Interpersonal interaction processes, such as conflict or affect management as well as team member motivation (Marks et al., 2001) seem to be intertwined with the actual task mode. Marks et al. (2001) distinguish three central interpersonal processes:

- Conflict management, which is subdivided in preventive and reactive conflict management
- Motivation and confidence building, which implies collective confidence building, goal orientation and task motivation
- Affect management, which involves the emotion regulation function of interpersonal processes managed by principles of social cohesion, dealing with frustrations and excitement

Those team interaction processes do not imply other team performance episodes, but do adapt themselves to the requirements of the specific task-related activity mode. In this sense, they are closely coupled to the task work episodes. As for this contribution, a specific focus on processes of social categorisation (J. C. Turner et al., 1987) is deemed as more prolific for understanding the mentioned subgroup dynamics in faultline teams (Thatcher & Patel, 2011), the interpersonal processes as described by Mark et al. (2001) will not be further elaborated. Important, however, seems to be the notion that task work episodes are tightly coupled to team processes such as social categorisation. A model of team performance episodes (Marks et al., 2001) will be taken into account for exploring the global dynamics in the teams under study.
3.4.1.2 Qualitative inquiry of global team dynamics

In groundbreaking studies by Gersick (1983, 1988, 1989) in regard to the analysis of trajectories and global dynamics of teams seen as complex open systems, the study taskforce teams - teams that only were composed for one task purpose - have to be mentioned. She explored the influence of external 'zeitgebers', such as deadlines, on team dynamics. Every team she studied followed a different trajectory of team phases as postulated in the classical team phase models (see for example Tuckman, 1965). In the studies of so-called task force teams the deadline of the team task functioned as temporal pacer, which influenced episodes of stable inertia and transitions.

The qualitative studies of adhoc teams in differing contexts conducted by Gersick (1983, 1988, 1989) provide evidence that teams show a similar pattern of punctuated change in the midpoint between the start of the task and their deadline. The major similarity that could be found between teams in those studies was that every team developed a task and team role orientation as soon as the first meeting took place, and then stayed within a work and team mode for the first phase till half of the time allotted for task accomplishment. Then, a major transition regarding team and task work orientation could be identified in all of the teams. In a highly interdependent phase of change the groups 'dropped old patterns, reengaged with outside supervisors, adopted new perspectives on their work, and made dramatic progress' (Gersick, 1988, pp. 16). Especially, through the groups interaction with their environments in such punctuated transitions new orientations towards task and team work were shaped and resulted in a new phase of inertia until the deadline of the team task approached.

By taking a temporal stance, Gersick (1988) described the identified global similarities between teams in analogy to American football games, as quarters with a major half time brake. The major half time brake was conceptualised as a transition episode. Such transitions were caused by a shift of attention towards the time left for task accomplishment. At least in the field study (Gersick, 1983, 1988) such shifts involved dynamics in the environment, for example an input, which came from respective customers, as well as endogenous dynamics, for example when individuals developed new ideas, which then were adapted by the group.

The study of adhoc teams by Gersick (1983, 1988) points towards two highly relevant facts when looking at team dynamics from an open, dynamic systems perspective. First of all, the very initial phase of teams seems to be highly relevant in structuring a first task and team work orientation. In f2f teams such an initial orientation emerges implicitly through the first interactions between team members. Studies in the field of social entrainment provide evidence that members of a team are able to synchronise their team task rhythms nearly automatically in collocated settings (Gersick & Hackman, 1990; Harrison et al., 2002). Secondly, the importance of unexpected transitions was
pointed out by the model. Such transitions occurred at the midpoint of the life cycles of the adhoc taskforce teams. Such transitions were studied as triggers for reflexion and team learning behaviours in teams (Oertel & Antoni, 2014). Therefore, in the next subchapters further empirical studies in the field of global team dynamics, concerning unexpected transitions or events with relevance for the context of distributed global teams will be outlined.

3.4.1.3 Social entrainment studies on the team level

Social entrainment is considered by Harrison, Mohammed, McGrath, Florey and Vanderstoep (2003) as a good concept for conceptualising temporal factors, which effect global dynamics in regard to the task environment. As outlined before (Gersick, 1988), social entrainment with reference to team task performance is conceptualised as the pacing of a teams coordinated actions according to an external deadline. Such pacing cycles can be viewed as episodes of goal directed task performance (cf. Marks et al., 2001). According to a large body of empirical literature (see Harrison et al., 2003 for a good overview), it was shown that teams synchronise their pace of coordinated activities according to external forces such as deadlines. This observation holds for different task types such as more complex problem solving group tasks (cf. Reid & Reed, 2000; Warner, 1992), or for behavioural coordination tasks such as in sport teams (McGrath & Kelly, 1986). Initially, teams adapt to external conditions in the task environment. In a study by Kelly, Futoran and McGrath (1990), it could be shown that when team members perceived the task as a capacity problem (e.g. not being enough people or having enough time for the task), they paced up their coordination behaviours, this pace was repeated in the subsequent trials, even if the capacity problems were reduced (for example by adding further team members, or giving more time). A different pacing pattern could be observed, when team members perceived the task as cognitively challenging. In such more complex task contexts, the initially entrained behaviours had a slower pace. These studies could show that people adapt their pace of task work to initially given requirements.

According to the primary research interest in the following paragraphs empirical studies, which analysed global team dynamics in virtual or global and virtual team settings will be presented. A field study conducted by Maznveski and Chudoba (2000) provides evidence that it is important to structure global work rhythms of teams with prescheduled f2f-meetings. The global rhythms of effective work teams were structured by regularly re-occurring f2f-meetings, in which more complex tasks were performed in a synchronous and rich media setting. Such meetings allow for more complex group tasks, such as problem solving and decision making to re-establish a work orientation for the next phases of distributed work. It was concluded that the decision processes matched the overall temporal pattern of the re-occurring f2f-meetings. The study provides evidence for a temporal pacing effect of external 'zeitgebers', such as prescheduled meetings. In globally distributed
settings, it seems important that team members meet f2f to enable respective entrainment of coordinated activities in the globally distributed teams.

If possibilities for f2f interactions are missing, possible difficulties for social entrainment in partially distributed, global team settings are expected. Through a lack of shared context (cf. Cramton, 2002), implicit, non- or para-verbal interaction patterns, which decide about the work orientation in early team interactions, are not transmitted. This can lead to lower task performance in leaner media settings (Straus & McGrath, 1994). Additional studies, which tangle aspects of a dynamic (Waller, Zellmer-Bruhn, & Giambatista, 2002) or geographically distributed context (Conway & Limayem, 2008) further underline the limits of social entrainments in completely distributed environments. For example, a study by Labianca, Moon & Watt (2005) could show the effects of impeded pacing patterns, when the time of meetings do not match our prefixed temporal schemata (e.g. begin exactly at a full hour). According to temporal dispersion in globally distributed settings, such a temporal shift in meeting times has to be expected. Social entrainment, therefore, might not only be inhibited, it might also be influenced by geographical dispersion in differing ways.

In contradiction to the findings mentioned above, there is some evidence that even in lean media environments such as text based chats, team members adapt to each other's work pace. In a study by Campbell, Cothren and Burg (2010), participants who communicated in dyads over text-based media adapted to the pace of their counterparts. Furthermore, the social pace entrained in first encounters was brought into new dyads. When dyad partners did match their pace, the entrained tempo of response to chats was maintained. This provides evidence for a social entrainment effect in lean media environments such as text-based chats. So far there are inconclusive findings regarding entrainment effects in globally distributed settings.

### 3.4.1.4 Punctuated transitions and reflexive team learning

Contextual dynamics such as events and processes that disturb endogenous dynamics are seen as the other temporally defining factor of the teams studied by Gersick (1988). Such external dynamics are on the one hand able to de-synchronise endogenous rhythms on the other hand they function as important attractors for endogenous rhythms of complex social systems. Theories of event-based punctuated equilibrium (Gersick, 1991) question aspects of a linear causality inherent in phase or developmental models of teams (cf. Tuckman, 1965). In such models the cause can only be situated in the past of a complex systems, such as a work group. The idea of punctuated equilibria defines events caused by environmental or system internal dynamics, which set changes in a system’s task role activity orientations.

Already the qualitative studies by Gersick (1983, 1988, 1989) have pointed towards the importance of external dynamics such as events, for disturbing or re-entraining functions of respective team
episodes. In collocated work settings unexpected events inform team members about the requirements of the situation and thereby function as triggers for the mode of interaction that is required (cf. Zellmer-Bruhn, 2003). Analogous to the individual organism, social systems are enabled to switch between performance oriented modes and taking a reflective stance to select different future options. Unexpected events were discerned to be an important trigger for shifting 'cognitive gears' (Louis & Sutton, 1991). Switches from more action oriented modes towards more cooperative or reflexive modes allow for the development of a kind of self-conscious social system, which is able to re-construct its collective actions (Lewin, 1947b). According to the requirements of the situation, action oriented or reflexive modes of interaction can be chosen from the collective knowledge bases of the involved group.

In a study by Oertel and Antoni (2014) evidence for such a triggering effect of interruptive or unexpected events for team learning behaviours in students teams could be provided. The unexpected events lead to a switch in cognitive frames of the students towards a more reflexive team work mode. Those results extend the findings of a former study by Zellmer-Bruhn (2003), which demonstrated that interruptive events enable knowledge transfer and the acquisition of new work routines. The punctuated equilibrium model proposed by Gersick (1988, 1989) can be seen as a two point attractor as teams can be in phases of transition in the beginning and the midpoint of their task performance and phases of execution where a shared orientation towards task and team processes is achieved. The question remains if teams cycle between both extremes of processing of equivocal information, or if such changes have to be seen as punctuated changes in accordance with the perception of team deadlines as found in the studies by Gersick (1983, 1988, 1989).

The punctuated process described by Gersick (1988, 1989) includes reflexive communication between team members and external stakeholders, who enable a change in the team work orientation and the following team work processes in the second half until the teams reach their deadlines. According to a team learning perspective (Schippers, Edmondson, & West, 2015; Schippers, Homan, & van Knippenberg, 2013; Wiedow & Konradt, 2011) such transitions could also be viewed as processes of team learning incorporating reflective processes as well as concrete adaptations of team work processes, which result in the change of teams goal and task orientation. Team learning episodes can be compared to transition episodes as described by Marks et al. (2001). Reflexivity includes the reflection of achieved accomplishments and the development of new work frames for future actions. Team learning behaviours are required when a high equivocality of information is perceived in the team's context. Task-related equivocality (Daft & Lengel, 1986; Daft & Macintosh, 1981) requires adequate and open information processing among team members to adapt to respective changes in the environment. In a study by Wiedow and Konradt (2011) a two dimensional structure of team learning as team reflection and team adaptation could be empirically
validated. Team reflexivity involves cooperative processes (Yirjo Engeström, 1992) of overt reflection about a team's 'objectives, strategies (e.g. decision making), and processes' (West, 2000, pp. 7). It thereby incorporates reflexive elaboration of equivocal information in regard to a team's goals and means space to achieve them. Team reflexivity involves the reflexive discussion and evaluation of achieved means goal space and the implementation of discussed improvements (Schippers, Edmondson & West, 2015).

A recent review of virtual teams by Gilson, Maynard, Young, Vartianen and Hakonen (2015) found a gap in regard to studies, which focus on transition episodes or temporal effects of team learning. Only a few studies exist so far, which address transitions in distributed teams. So in the next subchapters, first, general studies on punctuated transitions will be described, to later on specify on effects of structural forms of interdependence and the global dynamics influenced by transitions in globally distributed team settings.

3.4.1.5 Unexpected events and transitions in distributed global teams

In the study by Waller et al. (2002) on dynamic deadlines, attention to time was measured over the span of the team's task. Even though they could find evidence for punctuated shifts in the work orientation, in a similar task as in the study by Gersick (1989), the attention to time did only increase when the deadline of the task was approaching. At midpoints the attention rather decreased. Those findings can be interpreted in a way that it's not the attention to time, which stimulates midpoint transitions, but rather the requirements of the creative task. Creative tasks require a shift from early information extraction and idea development and decision cycles (Janssens & Brett, 2006), to more implementation oriented cycles (Bledow et al., 2009). Such a shift might be induced by the demands of the task. For example, in a study by Lim and Murnighan (1994) no midpoint transitions were found in less creative bargaining tasks. Furthermore, the studies by Waller et al. (2002) and the extensive field studies by Gersick (1983, 1988) could find patterns of transactions with the external context in such phases. According to Gersick (1989) such patterns of external influences were more accentuated in the field studies.

In contradiction to the defining characteristics of complex tasks of global and virtual teams, the study by Maznveski and Chudoba (2000) did not identify transitions at the midpoint or in between respective scheduled team milestones. As mentioned before in their study, rather the rhythm of prescheduled f2f-meetings paced the global patterns of team interactions according to equivocality reduction (Daft & Macintosh, 1981). Therefore, the rhythm defined the processes, and not internal or external changes in the environment, as would be expected in more complex, innovative tasks. A study by Jarvenpaa, Shaw, and Staples (2004), which analysed differential effects of trust before and after midpoint meetings, indicates for some indirect evidence in regard to transitions in globally
distributed team settings. The study of midpoint transitions in globally distributed teams requires more in-depth, comparative qualitative studies, to understand the divergent findings mentioned above. An explanation why midpoint transitions in distributed teams are not that easily experienced could lie in the contextual dependence of the perception of respective dynamics. A qualitative field study by Grant, Schulze and Haasis (2003) could show that ambiguities and different understandings regarding work routines and standards are not perceived in the beginning of a collaborative project. The lack of contextual information in regard to standards led to what the researchers called a state of ‘illusory coordinatedness’, in which the engineers believed that everything was running according to plan. Only, after the engineers had seen the difference in standards in the respective work contexts, the divergent expectations in regard to planned coordinated activities clashed. The study shows, how unexpected developments can stay underneath the surface in distributed settings. When discrepancies emerge they result in respective high requirements for cooperation. In the described case, dynamics lead to a phase of being overcautious with all the information the team members from the other site provided. This slowed down all processes, and nearly hindered the efficient completion of the project. Ambiguities in globally distributed teams thereby might stem from the requirements of complex, equivocal tasks (cf. Janssens & Brett, 2006). In the same time, they might also be influenced by contextual factors, such as differing understandings of standards stemming from differences in organisational or disciplinary cultures (cf. Dekker et al., 2008).

3.4.1.6 Structural task interdependence as enabler in early distributed team episodes

A cross-sectional field study of virtual teams by Hertel, Konradt, Orlikowski (2004), which investigated management practices regarding the structuring of interdependence in virtual teams, provided evidence for the critical relevance task interdependence especially in the beginning of a virtual team’s life. Early task interdependences increased team performance via perceived instrumentality of team member’s contributions. In this study, goal or reward interdependences were relevant to virtual teams in all phases of their respective team lifecycles. In a study by Rico and Cohen (2005), which investigated the media-task fit in virtual teams, a fit of synchronous media to interdependent tasks could be shown. More complex tasks engender higher order information processing, which require higher degrees of interdependence in the virtual teams. Such convergent communication processes should be enabled by synchronous media settings (Dennis et al., 2008). The result with respect to requirements for synchronous media in intensively interdependent task settings may be taken as indication for the identified importance of f2f-meetings in the very beginning of creating shared problem awareness in transitive team episodes in the field study.
A study by Swigger, Hoyt, Sere, Lopez, Alpaslan (2012) showed that effective software development teams did more planning in the beginning and reduced the initially higher levels of social communication towards the end of the project. Furthermore, some interesting findings are derived from studies on the development of transactive memory systems (TMS; Wegner, Erber, & Raymond, 1991, pp. 923) in distributed and globally distributed teams. The development of transactive memory systems, as shared collective 'systems for encoding, storing, and retrieving information', are perceived to require the exchange of differing expertise. Through this exchange the knowledge of who-knows-what in distributed systems can be developed. The process of development of transactive memory systems can be viewed as a team learning process. In a temporally based study of the effect of transactive memory systems in virtual teams, Kanawattanacha and Yoo (2007) found that early task-related communication for creating a shared understanding of available competences and expertise in the distributed team setting, allows teams in later phases of their task cycle to work in a coordinated fashion. Therefore, the early exchanges of differing expertise enabled the development of a more stable transactive memory system, which allowed teams to coordinate their work efficiently.

A recent longitudinal field study of global supply teams (Maynard et al., 2012) provided evidence for the importance of task interdependences in very early phases of team work. High interdependence in the beginning of a team's life as well as the amount of time invested in preparation activities were identified as especially beneficial for enabling the development of a transactive memory system (Wegner, Erber, & Raymond, 1991). In a nutshell, teams which are enabled for transition episodes in which task-related information and information about expertise is exchanged, develop a shared understanding about coordinating the tasks. In globally distributed team settings such phases of cooperation or transitions in the beginning of innovative team projects could be even more important than in collocated teams, because entrainment patterns do not automatically emerge.

3.4.1.7 The combination of structural goal and task interdependences as enabler in distributed global teams

Studies about cooperative and competitive outcome or goal interdependence in the field of intercultural collaborations indicate, that in situations of cooperative goal interdependences, differing views and opinions may be integrated into innovative ideas (Chen, Tjosvold, & Su, 2005; Tjosvold & Su, 2007). As shown in a study conducted in China by Chen et al. (2005) the communication of differing ideas and perspectives between expat managers and local employees could be supported through the definition of cooperative goal structures. It could be extrapolated that especially in situations where there is a certain degree of team conflict, cooperative outcome interdependences lead teams to be more effective. But under conditions without salient conflicts, it
is unclear whether outcome interdependence significantly impacts innovative outputs (cf. Nijstad & De Dreu, 2012). Considering the results of increased group conflicts in faultline team settings (see Thatcher & Patel, 2012 for a review), the results given point towards the importance of structuring cooperative goal interdependences in such settings (Deutsch, 1949).

In contradiction to the main effect of goal interdependence, in a recent study of faultline teams (Rico et al., 2012) the mere creation of positive goal interdependences did not lead to a better team performance on decision tasks. In this experimental study, only the combination of defining superordinate goals and forming interdependent task work groups with members from the two faultline groups, led to higher team performance. The joint effect of goal and task interdependences was mediated by information elaboration. The combination of the two forms of structural interdependence to positively influence task performance is indirectly supported by studies under the theoretical paradigm of motivated information processing (see Nijstad & De Dreu, 2012 for a recent review of literature). For example Bechtoldt, Choi and Nijstad (2012) could show that team creativity and the originality of ideas is fostered by a combination of collectivistic value orientations with individualist self-construals. In this vein, results of a field study by de Dreu (2007) indicate that the positive effect of goal interdependence occur under conditions where people are motivated to elaborate and reflect task-related information more thoroughly. Such an increase in task motivation and the respective elaboration of task-related information could be influenced by structural task interdependences when combined with positively interdependent goal structures, which frame a prosocial, cooperative situation. The results of those studies point to a possible interaction effect between structural forms of interdependence and team reflexivity on performance.

Triggering effects of task characteristics, such as task-related cues, were shown to have an effect on contributions, and influence patterns on status characteristics and expectation states in teams (Driskell, Olmstead, & Salas, 1993). The influence of task-related cues, for example showing competence, might trigger influence patterns in teams and alter performance expectations in more complex decision making tasks. The manipulation of cross-cutting task roles (Bettencourt et al., 2007) indicates differing status characteristics. Thereby changes in established task structures influence patterns between the active faultline subgroups (Zanutto et al., 2010). As shown in the study by Rico et al. (2012), it seems that the combination of interdependent goal and task structures influences the cooperative perception of the situation and increases the motivation to process information.
3.4.1.8 Summary of the chapter on global dynamics of task-related processes

In a perspective of teams as complex self-organising systems, global patterns or rhythms can be understood as emerging from local interaction in respective team performance episodes (Marks et al., 2001). Episodes with high requirements for equivocal information transmission and episodes, which require synchronisation of actions within predefined cooperation structures can be distinguished (cf. Engeström, 1992; Wehner et al., 2000). Interactions in local episodes of coordinated action, corrective cooperation episodes, and episodes of expansive and extensive cooperation structure a global rhythm of task work. Therefore, global rhythms of team task work are conceptualised as a cycling between action and more reflexive transition episodes (Marks et al., 2001). Studies in globally distribute team settings (cf. Maznevski & Chudoba, 2000), could show that important external dynamics such as deadlines structure the global rhythms through processes of social entrainment. Entrained rhythms are perceived to structure interactions in the sense of learned communication patterns.

Less conclusive are the findings in regard to midpoint transitions and reflective transition episodes (cf. Gilson et al., 2015). But some empirical results suggest that especially in the beginning of global team work, highly interdependent reflexive episodes involving the exchange and elaboration of task and role-related information are crucial for innovative outcomes (cf. Kanawattanachai & Yoo, 2007; Maynard et al., 2012). The studies on structural forms of interdependences (cf. Hertel et al., 2004; Rico et al., 2012), indicate that the combination of structural goal and task interdependences engender global team dynamics for innovative team outputs in distributed or culturally heterogeneous teams.

In sum, further studies in the globally distributed context are needed to get an understanding of the structuring of task work processes over time. So far none of the studies presented allowed for the study of the influence of social or interpersonal team work episodes on respective task work episodes (Marks et al., 2001). Therefore, in the following chapters respective dynamics of social categorisation processes with relevance in partially distributed teams will be outlined.
3.4.2 Dynamics of social categorisation and the development of superordinate team identities

In the following chapter the effects of social categorisation on dynamics in partially distributed teams in a global context will be described. The social categorisation theory will be explained in more detail. Subsequently, the empirical limitation of the conditioned intergroup contact hypothesis originally developed by Allport (1954) will be outlined to come up with an explanation for the choice of the common ingroup identity model (Gaertner et al., 1993; Gaertner & Dovidio, 2000).

3.4.2.1 The social categorisation theory - an approach for understanding dynamics of categorization processes

According to the social categorisation theory (J. C. Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) individuals categorise themselves in a continuum ranging from the perception of themselves as individuals, to the perception of themselves as being in respective groups as compared to other groups. Thereby, all individual actions are defined to some amount by the personal as well as the group level identities involved in the situation (cf. Haslam, 2004). In the original approach of the social categorisation theory (Turner et al., 1987), three relevant levels of categorisation have been discerned: Categorisation as an individual, categorisation as a member of an ingroup in contrast to other groups, as well as the categorisation as a universal human being. According to Turner et al. (1987), the salience of the respective identity defines the actual behavioural mode. The switching between interpersonal and group modes can be conceptualised as a continuum. The quality of the interaction changes from group level to interpersonal behaviour, according to the poles individuals tend to self-categorise. In a group level mode individuals tend to perceive themselves as being more similar to other members of their ingroup, in the same time a sharper differentiation to members of outgroup members is perceived. Behaviours are becoming less individualised and more homogenous within the respective ingroups. Consequently, a certain stereotypical perception of the group members and a positive perception of the values held by ingroup members follow. The degree of the influence of social or group level categorisation depends on the cognitive accessibility of differentiating characteristics, on the normative fit of the differentiation for the individuals within the ingroup, as well as the comparative fit within the subgroup structure of the work group. In the following paragraphs, the principles of the social categorisation approach will be exemplified in relation to the context of partially distributed teams in a global context.

The accessibility of a respective category for differentiating between groups is influenced by socialisation factors through learning of the importance of different diversity characteristics in specific situations. Therefore, the organisation culture and established political and micro-political
factors have an influence in partially distributed work settings (cf. Janssens & Brett, 2006). In such work settings, the influence of respective leaders and the organisational culture has to be analysed. Leaders can prime the importance of specific diversity characteristics on a relevant job, for example, by constantly referring to a respective demographic or functional category. Therefore, the probability of categorising oneself on a group level and making comparisons between subgroups tends to increase, when respective leaders make explicit categorisations along the lines of differing characteristics (cf. Thatcher & Patel, 2012). A field study by Greer, Homan De Hoogh and den Hartog (2012) could show that a leadership tendency of categorisation according to diversity characteristics aligned with a visionary leadership style, negatively influences the performance of culturally diverse teams.

Comparative fit is defined by principles of meta-contrast (cf. Haslam, 2004), by which similarities between members of one category are compared to member differences on a relevant category. If similarities within a category are perceived to be higher than the differences, comparative fit increases. In diverse work groups with a high faultline strength (Thatcher & Patel, 2012), such demographic differences tend to create a higher comparative fit for comparing the faultline groups. Furthermore, in partially distributed teams the comparative fit in the sense of a meta-contrast for social categorisation is reinforced by the distributed work context. The distributed context makes a differentiation between the subgroups more salient, as it is reinforced through the interaction with the people in the local f2f subgroup settings. This reinforces comparative fit as the characteristics of dispersion often converge with differences on the demographic and diversity level. Empirical studies (Chiu & Staples, 2013; Hinds & Mortensen, 2005; Polzer et al., 2006) show that when differences of geographic distributions and cultural diversity converge, the probability for comparing groups along demographic lines increases.

Social categorisations are not directly related to negative outcomes such as increased intergroup conflicts in diverse work groups. Negative effects only come to forefront when there is a perceived threat to the identity of involved subjects or subgroups. When such a threat to identity is perceived social categorisation leads to the so-called intergroup bias (Branscombe, Ellemers, Spears, & Doosje, 1999). Intergroup bias represents favourable attitudinal as well as behavioural responses towards the ingroup, as well as negative stereotyping of the outgroup members. According to van Knippenberg et al. (2004), it is important, to distinguish between social categorisation and intergroup bias. Intergroup bias refers to the more favourable evaluation of ingroup members compared to outgroup members, whereas social categorisation does only involve the categorisation of oneself in relation to salient groupings in the context. According to a study by van Knippenberg and Haslam (2003, cit. in van Knippenberg et al., 2004), the mere categorisation of people into differing subgroups does not lead to intergroup bias in absence of relevant intergroup competition or conflict.
Social categorisation processes are connected to intergroup biases in the case of competition between subgroups. As will be outlined in chapter 2.3.2.3 the interdependence structures in partially distributed team settings are perceived to impact perceptions of the cooperative or competitive situation.

3.4.2.2 Normative fit and influential individual beliefs

Normative fit reflects how much a demographic category makes sense in the affective and cognitive frame of reference of a person. The normative fit of social categorisation processes depends on the subjective beliefs as well as stereotypes of involved individuals regarding the effects of diversity on the work in groups. The impact and relevance of respective categories depends on the individual beliefs a person holds regarding the impact of such categories in specific contexts. Such beliefs may contain stereotypes or racial prejudice towards relevant groups.

Most of these studies regarding individual frames of references (cf. Newheiser & Dovidio, 2012), beliefs systems (cf. Asbrock, Christ, Duckitt, & Sibley, 2012), stereotypes and prejudice (see Duckitt & Sibley, 2009 for a comprehensive literature review) have been conducted in the field of interpersonal interactions between people of differing gender, race, ethnicity or different sexual orientations. However, few have been conducted in the field of work or more specifically on the level of teams. On the level of work teams the concept of diversity beliefs has been defined by van Knippenberg and Haslam (2003, cit. in Homan, van Knippenberg, Van Kleef, & De Dreu, 2007, pp. 1190) as ‘beliefs about the value of diversity to work group functioning’. Diversity beliefs, unlike prejudice, focus on the instrumentality of diversity in work groups for goal attainment. By specifying the contributory focus of diversity, the construct of diversity beliefs does not overgeneralise the positive effects of diversity on all possible outcomes, but focusses on its contribution for achieving relevant tasks. Thus, diversity beliefs are differentiated from constructs such as diversity mindsets, valuing diversity or favourable attitudes towards outgroups (cf. Adesokan, Ullrich, van Dick, & Tropp, 2011). Diversity beliefs can generally be split into so-called pro-diversity beliefs, which value the impact of diversity on work group functioning and effectiveness, and pro-similarity beliefs, which state negative value the impact of diversity in workgroups and teams (van Knippenberg et al., 2007). Such beliefs are influenced by organisational climates and cultures (cf. Ely & Thomas, 2001). Differences occur also in regard to the task context, in which diversity becomes salient. Especially in distributed settings, in which personal contacts and informal communication tend to be on a lower level (cf. Hinds & Mortensen, 2005), members seem to recur more often on stereotypical beliefs about the other (cf. Polzer et al., 2006). In this thesis, diversity beliefs and their effect the development of a superordinate team category are of interest.
3.4.2.3 Structured intergroup contact conditions and social categorisation processes

To conceptualise the impact of interdependence structures and their impact on social categorisation processes we can now come back to theoretical assumptions made more explicit in the contribution by Allport (1954) mentioned before in the introductory chapter on structural interdependences (see chapter 2.2.5). According to the contact hypothesis structured interaction in intergroup situations leads to the reduction of intergroup bias and enable the development of more inclusive social categories. The intergroup contact hypothesis engendered a vast number of empirical, mostly experimental studies (see Dovidio, Gaertner, & Kawakami, 2003 for a comprehensive historical review), in which a first phase of cooperation within the ingroup is followed by a phase were people from the different ingroups have to cooperate to achieve a common goal. According to experimental studies summarised by Brewer (1996), the optimal solution of a superordinate category is given, when converging role structures cut across identification based subgroup structures. This approach is also called cross-cutting task role assignments (cf. Bettencourt et al., 2007; Marcus-Newhall et al., 1993) and studied more recently in the context of faultline teams (cf. Rico et al., 2012; Voida et al., 2012). A study by Marcus-Newhall et al. (1993) could show that when the roles of the individuals of differing ingroups were defined to be complementary to achieve the task goals, the effect of ingroup favoritism and outgroup differentiation would decrease more than in simple phases of cooperative interaction.

The results of a more recent meta-analysis of 515 empirical studies by Pettigrew and Tropp (2006) provides strong support for the argument that intergroup contact reduces intergroup prejudice. This effect seems to be particularly strong in the studies under the paradigm of optimal contact conditions as proposed by Allport (1954). Those studies were conducted in an experimentally controlled lab setting, and did operate with 'more rigorous procedures, more reliable measures' (Pettigrew & Tropp, 2006, pp.761). In their meta-analysis the conducted specific test of the individual contact conditions did not provide any significant regression with prejudice reduction; neither when combined or when entered as single conditions. Therefore, according to the meta-analysis the main effects of the intergroup contact could not be attributed to the contact conditions as originally stated by Allport (1954). Pettigrew and Tropp conclude that it might not be the structured contact conditions that influence the reduction of intergroup bias and prejudice, but rather the reduction of uncertainty in interaction enabled by processes of liking persons from the respective outgroups. Such processes are perceived to have a major impact on the reduction of negative feelings, such as anxiety or threat in intergroup relationships.

One important aspect, which has already been conceptualised in the social categorisation theory (Turner et al., 1987), is the possibility of interpersonal interactions. In interpersonal interactions group level identifications are less salient and individuals are enabled to perceive themselves as
individual personalities. Individual interaction allow for the perception of respective differences between outgroup members. In studies of interpersonal relationships in intercultural settings Hubbert, Gudykunst and Guerrero (1999) could show that interpersonal contact between members of differing cultures, over time, led to a switch in communication from social category based communication behaviours to a communication, which was guided by personal identities. The development of such interpersonal interactions was undermined by social anxiety. Communication behaviours such as self-disclosure, which reduced uncertainty, allowed for the development of shared expectations for appropriate communication behaviours. Therefore, the switch to interpersonal modes of interaction did not require interdependent goal structures or collaborative tasks. Merely interactions in situations that were not defined by intergroup threat were enough to reduce social identity categorisation.

In an experimental study by Gaertner al. (1999) interaction as a mere exchange of information of the group results, enabled the development of a superordinate group categorisation. Interesting for partially distributed teams was the manipulation of a partial interaction condition in the experiment. In this condition the participants of the subgroups were permitted to discuss preliminary results achieved in the subgroups only during short periods of time. The amount of communication in this experimental condition was sufficient to reduce the intergroup bias. Furthermore, the minimal interaction not only influenced the perception of the outgroup members, but rather influenced the perceptions of learning from one another, cooperation and superordinate categorisation. Perceptions of team structures such as of two subgroups in one group, followed by the perception of one overarching group also differentiated between the no- and partial interaction condition. This indicates that communication even without functional interdependence in the task work leads step by step to a superordinate categorisation, which is finally integrated in the perception of a shared team identity.
3.4.2.4 The common ingroup identity model as framework for understanding social categorisation processes

The interpretation of further empirical results (cf. Gaertner et al., 1993; Gaertner & Dovidio, 2000 for an overview of studies) lead to the development of the common ingroup model. In contrast to the cross-cut task role argument, studies under the common ingroup paradigm claim that functional interdependence is not a necessary condition to reduce ingroup assimilation and intergroup differentiation. The common ingroup identity model therefore proposes two processes of de-categorisation, which enable an interaction on the interpersonal level, thereby decreasing the salience of different subgroup categories:

- De-categorisation as a strategy to individualise and personalise for example by revealing variability in opinions within an outgroup through self-disclosure (Gaertner et al., 1993)
- De-categorisation by cross-cutting group role membership (Bettencourt et al., 2007; Marcus-Newhall et al., 1993), and forming new subgroups composed of members from different subgroups

By introducing a de-categorisation process through self-disclosure the common ingroup identity model introduces a possibility of enabling the reduction of the intergroup contact without the requirements of structured intergroup contact (Allport, 1954). Furthermore, the common ingroup identity model asserts that ingroup bias as well as intergroup conflicts are reduced by a reframing of cognitive representation of group membership from two groups to one group (Gaertner et al., 1993, pp. 6). Re-categorisation actually seems to work through processes of ingroup enhancement rather than outgroup de-evaluation. Through a more encompassing definition of the group boundaries the 'cognitive and motivational processes that produce positive feelings towards ingroup members' are extended. The common ingroup identity model proposes a maximum generalisation to other outgroup members if the identifications with initial ingroups are maintained within a 'superordinate common ingroup identity' (Gaertner et al., 1993, pp. 6).
Furthermore, the common ingroup identity model assumes different representational mediators of effecting from respective categorisation processes (see Figure 3). Through categorisations toward the primary group, intergroup constellations might emerge, in which two differing group identities are perceived to have an impact on behaviours. In intergroup situations through de-categorisation processes the relationships might be perceived on an interpersonal level. Through re-categorisation, a superordinate team identity is created, which includes the members of the outgroup in a more encompassing team identity.

The respective cognitive representations are assumed to have differential interrelationships with intergroup bias. The two groups' representations are assumed to increase intergroup bias, whereas the re-categorisation and de-categorisations are perceived to have decreasing, but qualitatively different effects on the intergroup bias. When intergroup relations are perceived on an interpersonal level, the intergroup bias is reduced through interpersonal processes. Such processes lead to a reduction of the valuation of the ingroup. Thus, respective cognitive frames represented by the ingroup become less important and less differentiated to that of outgroup members. Therefore, conditioned contact does not seem to play the priority as claimed by Allport (1954). In the case of interpersonal processes; it rather seems that such categorisations are influenced by basic motivational processes and respective belief structures (e.g. diversity beliefs see van Knippenberg et
al., 2007). Changing towards an overarching team category representation, however, reproduces ingroup favouritism effect on a more inclusive group level, including members from the outgroup. The common ingroup identity model thereby provides an opportunity to discern differential effects of categorisation in terms of the intergroup bias and allows for a more comprehensive understanding of the empirical results as reported in the meta-analysis by Pettigrew and Tropp (2006). Furthermore, by introducing the different cognitive representation or perceptions of the actual intergroup relationship as one group, two groups or interpersonal interactions the model proposes an important mediating relationship between the conditions proposed by Allport (1954), cognitive and emotional cues and the occurrence of the intergroup bias.

3.4.2.5 Summary of the chapter on dynamics of social categorisation processes

According to studies on intergroup contact (see Pettigrew & Tropp, 2006 for a review) presented above, it seems important to include the perception of the group relationship as an important mediator (cf. Gaertner et al., 1993; Gaertner & Dovidio, 2000). The effect of structural forms of interdependences could be shown to be less straightforward as initially assumed in the contact hypothesis by Allport (1954). To understand effects of structural task interdependences in partially distributed team settings, discerned individual characteristics, such as diversity beliefs (van Knippenberg et al., 2007), and available factors of interaction on the interpersonal level should be considered. Thus, processes of de-categorisation as proposed in the common ingroup identity model will be taken into account (Gaertner et al., 1993; Gaertner & Dovidio, 2000). The exploration of de-categorisation effects should enhance the knowledge on processes of de-emphasising site specific identities and interaction processes on the interpersonal level; whereas for the development of more inclusive team identities, processes of re-categorisation should be examined. The main focus of this research endeavour will be the effects of structural task interdependence on social categorisation processes and the respective team perceptions, which effect innovative team outputs. For the case of the thesis specifically dynamic effects of social categorisation and information elaboration (cf. van Knippenberg et al., 2004) over time will be of interest. In the following subchapter studies on interaction effects of task-related processes, for instance information elaboration and the discerned social categorisation processes will be outlined.
3.4.3 Categorisation-elaboration dynamics in team performance episodes

To understand dynamics of social categorisation and task-related information processing, first of all, the categorisation-elaboration model as proposed by van Knippenberg et al. (2004) will be introduced. This model is able to account for possible interaction or conditional effects of structural task interdependence on innovative team outputs. Subsequently, studies on structural interdependence conditions (see for example Rico et al., 2012) as well as impacts of personality characteristics, such as diversity beliefs and their impact on social categorisation and information elaboration processes in distributed faultline teams will be reviewed. For a comprehensive review of the literature on interaction effects, relevant studies were integrated according to their overall fit to the criteria. In the following review, the studies are structured in the first subchapter, in general studies, which give insight into team process interaction. In the second subchapter, studies will be summarised which highlight the interaction effects of information elaboration from a re-categorisation perspective (cf. Gaertner & Dovidio, 2000), and in the last subchapter, studies will be mentioned that are more inclined to understand the interaction between de-categorisation processes and task-related information elaboration.

3.4.3.1 Theoretical framework for understanding interactions between social categorisation and task based processes

The categorisation-elaboration model (van Knippenberg et al., 2004) claims a moderated mediation between social categorisation processes and elaborated information processing in diverse work groups. On the positive side diversity in work groups is related to a higher elaboration of task-related information and perspectives. Diversity in a broad sense, ranging from overt categorical memberships such as gender, race, etc. to deeper levels of functional or informational diversity for example regarding involved disciplines in problem solving groups, has the effect of involving different views and ideas regarding task-relevant information. Task-related information processing is mostly required in groups working on more complex non-intellective tasks, in which negotiation and exchange of perspectives in work groups for finding solutions is needed (Dennis et al., 2008). For such groups it is important that people are highly motivated for the demanding exchange of different perspectives and information regarding the task at hand. In the categorisation-elaboration model motivated information processing is moderated by social categorisation processes. In the model, categorisation processes are influenced by the factors of fit as mentioned in the social categorisation theory (Turner et al., 1987) and the identity thread influenced by the respective intergroup structure. In the following paragraphs empirical studies, which analysed conditional effects of social categorisation processes on task-related information processing in faultline or distributed teams will be described.
In first explorative studies, an attenuating relationship between effective task-oriented information processing and social categorisation processes in partially distributed teams could be observed (Huang & Ocker, 2006). Possible interaction effects between categorisation processes and task-related information processing might be moderated by structural interdependence conditions in partially distributed teams. Positive interdependence regarding goals, for example, is enabling functionally diverse management teams to process information, especially, when groups thoroughly reflect their processes and tasks (De Dreu, 2007). The common ingroup identity model (Gaertner et al., 1993; Gaertner & Dovidio, 2000) asserts that ingroup bias as well as intergroup conflicts can be reduced by a reframing of cognitive representation of group membership from two groups to one group. As the studies in social categorisation-elaboration paradigm indicate (cf. Dick, Stellmacher, Wagner, Lemmer, & Tissington, 2009; Homan et al., 2007; van Dick et al., 2008), processes of re-categorisation can positively interact with task-related reflection processes and negatively affect the salience of subgroup categories. The effect of objective demographic boundaries is influenced by processes, which are happening on the level of identification with the site specific work group or the identification with a superordinate category of the partially distributed team (cf. Rico et al., 2012). For the case of the thesis, specifically, dynamic effects of social categorisation and task-related information processing (cf. van Knippenberg et al., 2004) over time will be of interest. Therefore, in the next section empirical work on the level of temporal models of task work processes, and process models of social categorisation and team identification will be outlined, to develop the specific research questions regarding dynamic temporal effects of social categorisation and information elaboration.

3.4.3.2 Studies on interactions between task-related processes and categorisation processes in distributed faultline teams

First of all, studies on distributed demographic faultline teams are of interest. In explorative studies an attenuating relationship between effective task oriented information processing and social categorisation processes could be observed (Huang & Ocker, 2006; Panteli & Davison, 2005). If a demographic faultline is salient people tend to categorise themselves according to their site specific subgroups. Consequently, they show favourable behaviours towards their local subgroups. As could be shown in a field study by Polzer et al. (2006) this leads to conflicts of interest between the subgroups from the distributed sites. Moreover, distributed teams with subgroups compared to groups with isolated individuals at respective sites, did not develop qualitative transactive memory systems (O’Leary & Mortensen, 2010). In a similar vein, the meta-analysis on effects of faultlines conducted by Thatcher and Patel (2011) showed that race and gender - so-called surface level diversity characteristics (Harrison et al., 1998) - had a bigger impact on faultline strength; increased
relationship conflicts and decreased group cohesion when compared to deep level characteristics such as functional tenure, age, educational background and tenure.

Active faultlines (Zanutto et al., 2010), thus, disrupt effective team information processing through personal tensions and conflict. Such in-group/out-group demarcation processes might interrupt goal driven collaborative task work efforts in a distributed setting. For example, the same task-related information contributed by out-group members is not processed as thoroughly as messages originating from in-group members (Mackie, Worth, & Asuncion, 1990); or information concerning the in-group are processed more thoroughly than when concerning the out-group (Maitner, Mackie, Claypool, & Crisp, 2010). Furthermore, as an experiment on information exchange in diverse work groups indicates (Phillips, Mannix, Neale, & Gruenfeld, 2004), processes of information sharing and processing in decision making tasks are influenced by the balance of membership within diverse subgroups. In balanced groups, such as in partially distributed teams, the processing of out-group members information is less likely to occur than in non-balanced minority groups. According to Gibson and Vermeulen (2003) not only the subgroup balance but also faultline strength (Thatcher, Jehn, & Zanutto, 2003) has an important impact on team performance. The study could show that in faultline teams, which had a moderately strong faultline strength, learning behaviours and performance on more complex tasks increased. In subgroups with a high faultline strength they decreased. In groups with strong faultlines, learning behaviours could be fostered in the presence of an external leader, which implemented a performance management that lead the teams reflect their task progress.

In the faultline research paradigm, studies which discern information related faultlines and demographic faultline have to be taken into account (cf. Bezrukova, Jehn, Zanutto, & Thatcher, 2009). Information-related faultlines have been added to include not only demographic characteristics, but also functional or informational diversity characteristics (cf. Jehn et al., 1999), which are directly relevant for the accomplishment of respective team tasks. Informational diversity in work groups should foster the capacity for deeper elaboration of task-related information when the task requires the integration of differing knowledge perspectives. If informational diversity is aligned with categorical diversity characteristics, such as age and gender, and when they converge along subgroup lines, they can foster the development of active faultlines in the groups (Zanutto et al., 2010). Such active faultlines might hinder further elaboration of task-related information (Thatcher & Patel, 2011). In a study by Homan et al. (2007) it could be shown that in informationally diverse faultline teams, the manipulation of positive diversity beliefs lead to higher group level information elaboration, which resulted in higher quality decision making. Therefore, it can be assumed that diversity beliefs condition the impact of informational diversity characteristics, when they are aligned with demographic faultlines. Such beliefs might facilitate the bridging of
informational dividing lines. A study by Meyer and Schermuly (2012) indicates that for complex problem solving tasks this conditioned effects has to be extended to include task motivation. Their results underline that diversity beliefs were not enough to significantly change task-related information elaboration in the process of solving complex problems. Diversity beliefs had to be combined with intrinsic task motivation for solving such problems to induce the relevant effects for enabling better problem solutions.

In regard to team identification only one study could be found, which investigated differential effects of the discerned structural forms interdependence in multidisciplinary teams (Van Der Vegt, Van de Vliert, & Oodterhof, 2003). In informationally diverse teams only the combined effects of structural goal and interdependent tasks engendered the development of a superordinate team identification, including the members from diverse disciplines. When the interdependence structures did diverge, for example when negative goal interdependence was coupled with high requirements for interdependent task work or vice-versa, a negative relationship to the development of an overarching team identity could be observed. So for demographic as well as for informational faultline teams (Bezrukova et al., 2009) the effects of structuring the goals and task interdependences on team innovation should be taken into account. In the following subchapters studies will be outlined, which directly investigate the relation between re- and de-categorisation processes and task-related information elaboration.

3.4.3.3 Interaction between re-categorisation and processes of task-related information processing

Empirical studies are now outlined, which address more specifically the re-categorisation process (cf. Gaertner & Dovidio, 2000). In re-categorisation processes a new, more including, team identification is developed, and shows respective effects on social as well as task-related team outputs. In a study by Bezrukova et al. (2009) it could be shown that informational faultlines are bridged by the development of a superordinate team identification. Team identification, thus, was modelled as a moderator, which helped teams with informational faultlines to perform better on their job. In a simulation study conducted by Voida et al. (2012) a related effect could be discerned by comparing distributed team settings to collocated team settings. The study provides evidence that in distributed team settings, which align with demographic diversity faultlines, team identity does moderate the performance on a trading game. It was shown that in teams with a higher superordinate team identity more goods were traded.

Re-categorisation processes studies which include subjective diversity or perceived diversity (cf. Shemla et al., 2014), are of special interest. Such studies allow for an assessment of categorisation on the level of categorisation processes. According to the social categorisation theory (J. C. Turner et al.,
1987), the inclusion of one self and others within one single group engenders the assimilation regarding the perception of within group similarities. The perception of within group differences thereby can be taken as an indication for the categorisation of others, different from self and other ingroup members. Thus, it can be assumed, that the perception of subjective diversity within work groups or teams is negatively related to the development of team identification. However, studies investigating the impact of individual characteristics, such as diversity beliefs (van Knippenberg et al., 2007) provide insight that this relationship might not be that straight forward.

In a longitudinal study by van Dick et al. (2008), a conditional effect of diversity beliefs on the subjective perception of diversity on the development on team identification could be shown. Thus, it can be argued, that when individuals hold positive beliefs about the impact of diversity in work teams, perceived diversity does allow for the development of a more inclusive team category. Furthermore, this study provides evidence for an indirect effect of the developed superordinate team category on task-related information processing. Even if this effect could not yet been related to task performance, it shows that in diverse teams the development of a team identity fosters learning behaviours such as task-related information elaboration. Similar results, which claim for a positive effect of team identification on subsequent task-related learning processes, are provided by Van der Vegt and Bunderson (2005) for multidisciplinary teams.

The conditional effect of diversity beliefs on the development of team identification, could be replicated and extended towards emergent emotional or affective states of the groups in a more recent study by Hentschel, Shemla, Wegge and Kearney (2013). It could be shown that the diversity beliefs moderate the perception of diversity and consequently influence the affective state of the team. The affective team state mediates the development of a more inclusive team identity. In teams holding positive diversity beliefs the perception of diversity did leads to a positive affective state, which furthers team identification. In teams with negative or pro-similarity beliefs the perception of diversity did leads to negative affective team states, which furthers emotional conflicts. This shows that not only the mere perception of diversity, but the qualitative difference in relation to the affective reaction might be important for developing team identification (cf. van Knippenberg et al., 2004). In a nutshell, these studies indicate for a positive relationship between the development of a superordinate team identity and respective task-related information elaboration, but they do not yet confirm the interaction effect of a superordinate team identity and task-related information processing on team performance on more complex task-related.
3.4.3.4 Interactions between de-categorisation processes and task-related information processing

A recent study in geographically distributed faultline teams (Chiu & Staples, 2013) provides evidence that the above mentioned, conditioned indirect effects of information elaboration on the performance in complex tasks is connected to de-categorisation processes. As a relevant effect the proponent of the common ingroup identity model (Gaertner et al., 1993; Gaertner & Dovidio, 2000), introduced the notion of social attraction and the process oriented variable of self-disclosure (Hubbert et al., 1999). Social attraction as the desire to socialise with relevant others (McCroskey, McCroskey, & Richmond, 2006), induces the feeling of closeness and thereby reduces differentiation between the person itself and others. Thus, social attraction should support de-categorisation processes. Public self-disclosure in a weblog before the experimental group decision making task did directly influence task-related information elaboration in a study by Zanutto et al. (2010). In this study de-categorisation processes did decrease the perception of active faultlines in the teams under the self-disclosure condition. Teams that actually engaged in active self-disclosure, did elaborate their task-related information more thoroughly. Depending on the social attractiveness induced by their weblogs posts, team members did perceive their counterparts as less different, which mitigated the negative effect of diversity faultlines. Furthermore, the study could show that task-related information elaboration did attenuate the negative effects of perceived faultlines. This study provides evidence for interaction effects between task-related information processing and social categorisation within a de-categorisation framework.

An interaction effect between social categorisation processes and information elaboration on team performance could be shown for faultline teams in a study by Meyer, Shemla and Schermuly (2011). They could show that social category salience conditioned the effects of faultline strength on information elaboration and consecutive performance on a desert survival task. Weak social category salience allowed for higher levels of information elaboration, giving indications for a process of de-categorisation (cf. Gaertner & Dovidio, 2000). The results of their study, led to the conclusion that it was important to assess categorisation processes according to the perception of salient diversity characteristics apart from faultline measures (Zanutto et al., 2010). The assessment of salient diversity characteristics provides in-depth insights into social categorisation processes consistent with the three principles of social categorisation (J. C. Turner et al., 1987).

The findings of the rare studies on de-categorisation and information elaboration are consistent with the literature on interpersonal contacts in intercultural settings (Hubbert et al., 1999) and empirical studies in the common ingroup paradigm (Gaertner et al., 1999, 1993 see chapter 2.3.2.4). In sum, the empirical evidence points towards the importance of de-categorisation processes for the perception of task-related differences.
3.4.3.5 Summary of the chapter on interactions between social categorisation and task-related information processing

First of all, some studies (Gibson & Vermeulen, 2003; Rico et al., 2012) provide evidence that interaction effects between categorisation processes and task-related information processing might be moderated by structural interdependence conditions in partially distributed teams. Even though the study by Van der Vegt et al. (2003) provides some evidence for combined effects of structural forms of interdependence on the development of team identity, so far no studies could be found - at least for faultline teams - which directly relate structural task interdependence with the development of team identification. Therefore, a study of the discerned effects of structural task interdependence on the interaction between social categorisation and task-related information processing is projected to be fruitful to gain further scientific insights.

On the level of team inputs, the impact of diversity beliefs (Homan et al., 2007) in relation to processes of re-categorisation has to be taken into account. Diversity beliefs conditionally influence the development of a more inclusive team identity in partially distributed faultline teams, mediated by the perceived diversity (van Dick et al., 2008) and the affective state in teams (Hentschel et al., 2013). Therefore, the inclusion of individual characteristics, such as diversity beliefs, will be taken into account in terms of their influence on interactions effects on task-related information processing and social categorisation.

The relationship between the interaction effects of task-related information processing and social categorisation processes seem less straightforward, according to the reviewed empirical literature. In studies examining re-categorisation effects (cf. Hentschel et al., 2013; van Dick et al., 2008; Voida et al., 2012), a conditioned serial indirect effect of team identification via information elaboration on task performance was assumed, but could not be conclusively tested. In the sparse studies which focusses on de-categorisation processes (cf. Chiu & Staples, 2013; Meyer et al., 2011), the aspects of team identity play no direct role, when the influence on task performance is concerned. Nevertheless, conditioned indirect effects regarding self-disclosure behaviour (Zanutto et al., 2010) or decreasing social category salience (Meyer et al., 2011) links information elaboration to performance outcomes on more complex team tasks.

It is concluded, here, that the different categorisation processes might have distinguishable interactions with task-related information processing. Further studies are required to grasp the complex interaction effects for respective team tasks. So far solely studies could be found, which analyse categorisation-elaboration interaction effects during whole task cycles. According to the differing team episodes during tasks cycles, it is deemed necessary to look at respective interaction effects of structural task interdependence in specific team performance episodes (Marks et al., 2001). The goal of this thesis is the exploration of differential interactional effects between task-
related information processing and social categorisation in enabling team performance episodes during the process of a whole innovation project.
3.5 **Explorative research questions**

As outlined in the theoretical chapters the research interest of this thesis focusses on the exploration of effects of structural task interdependence. Regarding structural task interdependence the conceptualisation of Wageman (2001) is taken into account. In a open, dynamics and complex systems perspective (Arrow et al., 2005, 2000) task interdependence is conceptualised as major attractor or primary boundary condition (cf. Emery & Trist, 1969) for defining different global patterns or rhythms in globally dispersed teams. Global patterns are conceptualised as being in relation to the relevant defining, contextual characteristics of such teams. Therefore, the interaction of structural task interdependence with the defining contextual parameters (task equivocality, cultural diversity and contextual dispersion) is examined, to explore similarities in global patterns of behavioural interdependence. The leading research question thereby can be formulated as follows:

(1) How does structural task interdependence influence the global dynamics in partially distributed global teams?

To answer the central research question relevant subquestions have to be explored, which address the local dynamics that constitute the discerned global patterns. First of all, it is required to discern relevant team performance episodes (Marks et al., 2001) in more complex tasks requiring diverse information extraction and integration (Janssens & Brett, 2006). Therefore one focus is set on the influence of structural task interdependence on collaboration processes requiring task related information processing in innovation enabling episodes. Therefore, the second order research questions will address the following explorative research questions regarding task work processes:

(2) How are global task processes structured in partially distributed global teams?
   a. by global rhythms of behavioural interdependence
   b. by innovation enabling team performance episodes
   c. by local processes of collaboration and goal and task-related information elaboration

Secondly, the same exploration is required to account for respective team processes in regard to social categorisation (J. C. Turner et al., 1987). Thereby, the social categorisation processes as claimed in the common ingroup identity model (Gaertner & Dovidio, 2000) should guide an open and explorative research process.
(3) How are social categorisation processes structured in partially distributed teams?
   a. by the subgroups dynamics caused by specific contextual dispersion
   b. by social categorisation processes

To come up with an understandings of categorisation-elaboration processes (van Knippenberg et al., 2004) in respective team performance episodes (Marks et al., 2001) the interactions between task-related information processing and the social categorisation in respective episodes should be explored. Therefore, such interaction processes were explored in respective team projects involving innovative team tasks.

(4) What is the relationship between task-related information processing and social categorisation processes in innovation enabling team performance episodes?

Referring to the identified gap of studies of interactions which provide evidence for the link interaction effects of task-related information processing and social categorisation processes on team outputs such as innovation, furthermore, the interactions in innovation enabling task work episodes and their overall effect on innovative team outputs will be explored.

(5) How are innovative team outputs related to the global process dynamics and respective structuring dynamics in the discerned team performance episodes?
4 Empirical studies

Knowing that the research questions imply several highly complex interrelationships between the above mentioned theoretical constructs, an explorative research methodology was chosen. The research framework (see Figure 1) integrating the above mentioned theoretical concepts was applied in the sense of a so-called sensitising framework (Blumer, 1954). The framework and respective research questions were furthered adapted and refined during the whole research process. This process was guided by a explorative qualitative research paradigm (Kleining & Witt, 2001; Kleining, 1982, 2007), which will be outlined in the following subchapter. Furthermore, in the chapter a first explorative field study will be presented, in which first theoretical propositions were developed. Some of those propositions were tested in a simulation study, which will be presented in the second part of the empirical chapter.

4.1 Methodology

For the study of communication dynamics in partially distributed global teams understood as open, dynamic and adaptive systems the research propositions made by Arrow et al. (2005, 2000) to study groups were taken into account. According to this research strategy it is proposed to adapt research methods, which allow the study of groups under more or less naturalistic conditions. The study of groups conceptualised as complex systems requires a focus on natural groups that function independently of the research endeavour. Such an approach should enable the understanding of complex, interdependent relationships within respective contexts of work groups. Methods to study groups in more naturalistic settings include comparative case studies, computational as well as experimental simulation. In the case of this thesis one comparative case study and an experimental simulation were conducted. Both studies explore global and local dynamics of task interdependence over the span of a concrete team project.

Furthermore, an understanding of groups as complex, adaptive systems (Arrow et al., 2000) requires the study of groups by within-case-analysis of trajectories of global group variables over a meaningful period of time. Dynamic changes of team level structures and behaviours cannot fully be specified from detailed analysis of isolated system elements. The variables involved in global dynamics are as such emergent aspects of the system, rather than the simple aggregation of local variables. Those emergent variables can have different equilibria. They are evolving in specific patterns in dependence of the team context and the local interactions between the team members. Such patterns of the trajectories of global variables should be analysed by considering interdependence dynamics among the group members and the influencing aspects of the group's context.
The study of patterns of group dynamics and trajectories according to Arrows et al. (2005) is connected to major analytical complications. First of all, the analysis of group dynamics or trajectories over time with conventional statistical methods results mostly in rather complicated interaction effects. Thereby, significant effects of time have to be considered. To really understand such complicated relationships it becomes necessary to ground the findings and develop theory by assessing qualitative data. As pointed out by experienced researchers (cf. Arrow et al., 2000; Gersick, 1988; McGrath et al., 2000), qualitative data from field notes, recorded conversations as well as individual diaries as well as group reflection workshops are really helpful to understand respective group dynamics. It seems important to rely on qualitative and quantitative data to come up with a theoretical understanding of groups and their changes over time. To facilitate a comprehensive understanding of groups as complex systems, which adapt to their environments in cycles over time, it seems more appropriate to use a combination of qualitative as well as quantitative research strategies.

According to Kleining (1982) all research methods ground in everyday practices of analysis and reflection of idiosyncratic experiences. Qualitative and quantitative methods of social science differ in their degree of abstraction from the everyday practices of analysis and reflection. Together, they build one system of methods to grasp human phenomena. The research addressed in this thesis is divided into two major phases regarding the involved research strategies: the phase of heuristic-qualitative research (Kleining & Witt, 2001) concentrating on contextually meaningful dynamic process relationships in partially distributed, global teams. This was enabled by an open research framework in the study towards global similarities in process dynamics between maximally differing cases. The second phase of quantitative research focused more on explaining discovered similarities by holding constant important variables and explaining between group variance.

In the first heuristic and explorative phase (Kleining & Witt, 2001; Kleining, 1982), to get a full grasp of the research topic to define and revise initially stated research questions, the emergent structures and patterns of trajectories in partially distributed teams were explored and discovered. Furthermore, this understanding was grounded in the everyday experiences of people who are working in partially distributed global work settings (cf. Glaser & Strauss, 1967). The discovery guided a process of development of heuristic-theoretical propositions regarding the structuring of communication in everyday work settings. Those developed heuristics do not abstract or transcend from the experiences of involved people in those settings (cf. Kleining, 1982). They were used to further develop the collaborations between dispersed people according to the situational organisational and individual needs. The first phase served for the development of a first order substantive theoretical propositions according to the stated principles developed by the Hamburg school of explorative-heuristic research (Kleining & Witt, 2001; Kleining, 1982). By mirroring the first
order theoretical propositions with respective theoretical and empirical research, a pragmatic
development of second order theoretical hypothesis was enabled.
The second phase of research focused on those abstract theoretical hypotheses. Thereby, the aspect
of methodological continuity (cf. Kleining, 1982; Blumer, 1954) inspired the development of an
experimental simulation that should reflect as neatly as possible real-world phenomena. The second
phase was guided by the principles of more linearly conceptualised quantitative research and
involved the falsification of the stated heuristic propositions of the first phase of the research
process. According to Witt (2001) this phase was oriented towards distinctiveness of respective cases
with different initial, experimental conditions of structural task interdependence. Effects of task
interdependence on mediating processes such as social categorisation and task-related information
elaboration (van Knippenberg et al., 2004) and their interactions in regard to effects on innovative
team outputs were tested in this phase.
4.2 Field study: Exploration of behavioural interdependence in partially distributed global teams

Research of small groups or teams understood as adaptive complex systems requires an exploration of patterns with regard to global group dynamics over time (cf. Arrow et al., 2000). Therefore, an explorative-heuristic research strategy with a specific focus on naturalistic everyday work practices, and a dialogical orientation guided by the principles developed within the Hamburg school for qualitative-heuristic research was chosen (Kleining & Witt, 2000, 2001). The primary goal was the exploration of trajectories of communication intensity in innovation projects.

The maximal variation of perspectives should enable an assessment of data, which challenge the theoretical pre-conceptions of the researcher (Witt, 2003). Thereby, the general topic of the explorative study was the analysis of partially distributed teams as an extreme case for forming a shared team. Heuristic and exploratory research methods should enable a systemic analysis of the everyday practice and allow the insight in multiple perspectives on the global interdependence dynamics over time. The principle of variation of perspectives was further respected in the type of data collected (Kleining & Witt, 2001). The data included explorative observational data and protocols, interview transcripts, graphical representations of the structuring of communication intensity as well as questionnaire data of communication events assessed over a period of three weeks in selected projects.

Following the rule of openness of the research person and the object or trajectories under study (cf. Kleining & Witt, 2001), the sensitising framework (Blumer, 1954) was developed from a first understanding regarding the concept of structuring of communication intensity over time as used in the study by Maznevski and Chudoba (2000). The goal of choosing a sensitising concept was to give a certain direction of where to look at in the research process, by providing evidence for relevant aspects, rather than predefining fixed concepts of operationalisation (Blumer, 1954). To study everyday experience, sensitising concepts place us in the position to point out the unique or distinct character of a research object by addressing the commonalities between comparable objects. According to Blumer (1954, pp. 8): 'we have to accept, develop and use the distinctive expression in order to detect and study the common'. Therefore social research should be guided by concepts, which allow the detection of distinctiveness in everyday practice.

For the exploration of the structuring, interactional intensity was chosen as a sensitising concept (cf. Maznevski & Chudoba, 2000). Rather than giving a clear cut definition of interactional intensity the concept was explained by giving illustrations or expositions to real world situations, 'which enable to grasp the reference in terms of one's own experience' (Blumer, 1954, pp. 9). To progressively develop and refine early pre-conceptions, a certain degree of openness towards the detection of different aspects of the concept in varied empirical instances is required. Openness as well as the
orienting aspect of the sensitising concept should enable the discovery of its full structure including emergent aspects. Guided by the early concept of interactional intensity, a cross-case study was conducted to get a grounded understanding of the trajectories of communication in partially distributed teams.

The sensitising framework for assessing dynamics of behavioural interdependence was further developed throughout the cyclical process of data assessment and analysis, through the collection of data from various sources and the study of a diverse body of theoretical and practical literature (cf. Blumer, 1954; Kleining, 2007). The first open research question was guided by the discovery that some of the partially distributed teams did not perceive themselves as teams (Ryser et al., 2011). This explorative finding was followed by a process of investigation and asking new questions and applying new methods in the interaction with globally distributed team members. Such a process is described by Kleining (1982) as a cyclical process of dialogical questioning (see Figure 4). The process involved the questioning of contextual and process related factors, which lead to the identification with the team in the partially distributed context.

Figure 4: the cyclical, qualitative-heuristic research process (adapted from Kleining, 2007)

For a next cycle of research, questions were refined and now addressed more specifically the intersection of social and task work processes regarding the creation of patterns of behavioural
interdependence, which enable the development of shared team perceptions (cf. Ilgen et al., 2005; LePine et al., 2008). This led to a first order grouping of trajectories or rhythms of behavioural interdependence and respective emergent qualities (Kleining, 1982). In the sense of an explorative research endeavour early data assessment helped to refine the concepts under study, and fostered further data assessments to explore the phenomenon of behavioural interdependence over time. Over the whole research process the sensitising framework was conceived as open for change (rule two for heuristic research stated by Kleining & Witt, 2001). Therefore, the focus of research was expanded towards finding connections between the structuring of behavioural interdependence over time and its influence on social as well as task-related processes as well as emergent team perceptions. In the last step of the heuristic research process, first order heuristic relationships were mirrored with respective literature, to develop second order substantive theoretical proposition, which allow for the development of research hypotheses.

4.2.1 Selection of cases and contextual case description

In this study eleven teams in three different cases located in Switzerland were studied. The selected teams had tasks involving topics on a global scale. The principle of maximum variation of perspectives (cf. Kleining & Witt, 2001), guided the sampling process in considering the defining contextual parameters, such as tasks, type and degree of cultural differences as well as type and degree of aspects of geographical distribution. Therefore, specific, defining aspects, such as the type of team objectives and tasks, the type and degree of cultural differences involved in both the differing cases, the degree of spatial and temporal distribution as well as electronic dependence was varied. By holding constant the contextual distribution across cases and the aspect of working on tasks with global relevance (cf. Janssens & Brett, 2006), the maximum variation of the mentioned defining characteristics should support the exploration of differences and similarities across three maximally differing cases of partially distributed global teams (see Table 1).

Regarding tasks, the cases varied from mechanical design and development tasks in bigger distributed machine development projects in case two; to mechanical integrity calculations or software development in case one; to process harmonisation and process innovation tasks between two production sites in case three. In regard to the aspect of interdependent goals, in case one and two the partially distributed teams of interest were embedded in bigger globally distributed R&D projects. They had project-based review reporting structures, with site specific individual evaluations and reward systems. In case three both sites produced the same pharmaceuticals and thereby had to be certified for the same, international regulatory quality and security systems. The dual sourcing strategy required a harmonisation of production processes and quality management processes at both sites. The harmonisation tasks in case three were organised rather informally, mostly without
explicitly externalised coordination structures, whereby the tasks in case one and two were structured via project management standards.

Table 1: Overview of the defining contextual parameters of the involved business cases

<table>
<thead>
<tr>
<th></th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Switzerland - India</td>
<td>Switzerland - Croatia</td>
<td>Switzerland - Germany</td>
</tr>
<tr>
<td><strong>Type of Innovation</strong></td>
<td>Product development</td>
<td>Product development</td>
<td>Process improvements</td>
</tr>
<tr>
<td><strong>Structural goal interdependence</strong></td>
<td>Collaboration between OEM and supplier; company specific individual outcomes and evaluation</td>
<td>Collaboration between OEM and subsidiary; project specific reviews; subsidiary specific evaluation</td>
<td>Collaboration between sites involved in a merger; group specific bi-annual evaluation</td>
</tr>
<tr>
<td><strong>Task content</strong></td>
<td>Mechanical integrity and software development tasks</td>
<td>Machine design tasks</td>
<td>Process harmonisation to process innovation tasks</td>
</tr>
<tr>
<td><strong>Cultural differences</strong></td>
<td>Intercontinental collaboration</td>
<td>Inner-continental collaboration</td>
<td>Collaboration between neighbouring countries</td>
</tr>
<tr>
<td><strong>Geographical dispersion</strong></td>
<td>Time difference 3.5h-4.5h</td>
<td>No time difference, but different practices regarding working hours</td>
<td>No time difference</td>
</tr>
<tr>
<td></td>
<td>Flight 7 h</td>
<td>Flight 3.5h</td>
<td>Travel time 2 h</td>
</tr>
<tr>
<td><strong>Electronic dependence</strong></td>
<td>Medium-term collocation of Indian engineers to the Swiss OEM</td>
<td>Medium to long term collocation of Croatian engineers</td>
<td>No installed long-term Collocation plan</td>
</tr>
<tr>
<td></td>
<td>High degree of electronic dependence</td>
<td>Short term collocation in critical project phases</td>
<td>Short term collocation for meetings every 2-4 month</td>
</tr>
<tr>
<td></td>
<td>Medium degree of electronic dependence</td>
<td>Medium degree of electronic dependence</td>
<td>Medium degree of electronic dependence</td>
</tr>
</tbody>
</table>
Regarding types and degree of cultural diversity (cf. Harrison et al., 1998), the selected cases matched to the criteria of maximal variation of perspectives stated by Kleining and Witt (2001) as they involved in case one a maximally distributed context with a high amount of cultural diversity or distance and in case three a minimal case of geographical distribution with rather low amounts of cultural heterogeneity. Furthermore, the type of cultural diversity expected to have an impact on the collaboration differed between the cases, allowing for an analysis towards similar effects of different types of diversity. In case three, the history of a more or less recent merger (at the time of the study only ten years since the merger had elapsed) between the OEM in Switzerland (CH) and the subsidiary in Germany (DE) set the potentiality of salient cultural difference more on an organisational level. Even though minor differences between local cultures of people working in Germany and Switzerland should not be underestimated, the workforce on both sites and especially in Switzerland was quite nationally diverse. In case two, the merger between the Swiss OEM and the Croatian (HR) subsidiary dated back to the early 1990ies. Socialisation was fostered by long term co-location of Croatian engineers to the site of the Swiss OEM, thereby cultural differences on the organisational level were thought to have less impact. The cultural distance between people from Eastern Europe and central-western Europe was estimated to be considerable, also because of the rather rural context of the site in Croatia. Case one can thereby be regarded as an extreme case as it involved collaboration between different companies with no shared organisational culture and the highest distance regarding the cultures between Switzerland (CH) and India (IND), as well as spatial and temporal distance between the sites. According to the overarching dialogical principle of heuristic-explorative research (Kleining & Witt, 2001), the selection of teams and their respective variance on influencing contextual factors was discussed with involved people in the respective cases.

For example, in case one 30% of the Indian engineers were constantly onsite at the Swiss OEM according to the defined collocation plan. The Indian team at the Swiss site, however, was not located on the same floor as the Swiss engineers, thereby still a minimum amount of spatial distance was involved. This allowed for a variance of projects regarding the aspect of spatial distance. In this case four projects with comparable task complexity levels were chosen to be compared as evolving in a collocated setting or in a distributed setting (2197; 1122). Therefore, a further collocated project on the highest level of complexity was included (9008). The strategy of minimising or maximising geographical distance allowed for a comparison of dynamics of interactional intensity over time. This subsampling strategy in case one was important for the development of requirements regarding fully distributed work.
In case two two comparable projects were chosen relating to scope and duration. Both projects involved the development of a similar machine parts over period of two and a half to three years. In this case, the difference in the planned innovative outcome of the projects was varied. Project (ZIP) was planned to be the incremental development step of the same machine part, the second project (Z2) was set to be the more disruptive innovation step of the involved part. The project with the more incremental innovation step was initiated by the service organisation of the company. The service organisation was partially seated in Florida. For this study the formal subteam of the project ZIP, involving mechanical engineers from the Croatian and the Swiss side was analysed. In the project Z2 the collaboration included the Swiss OEM and the subsidiary in Croatia.

In case three four process harmonisation teams were selected with varied involvements in terms of the task scope as well as the frequency of regular meetings. Team No. 9 had a focus on strategic topics regarding process optimisation and technical alignment and met on a regular base twice a month; whereas team No. 6 focused on operative topics and met every second month in a f2f-setting. Team No. 6 had a special project-based task as they were involved in a process of machine acquisition, which was orchestrated as a cross-site project. Team No. 4 focused on the harmonisation on the level of one specific product and was initiated because of identified differences between the quality results of the sites. They officially met every quarter in a f2f setting. Team No. 5 was involved in an exchange about different practices of quality management and documenting between the sites and met also every quarter f2f. The variation regarding the tasks should also allow for differentiation between levels of involvement. Within the single cases the selection of specific projects allowed for further variance regarding the dependence on f2f meetings, an important aspect of the degree of electronic dependence (cf. Chudoba et al., 2005).

### 4.2.2 Cyclical Process of Data Collection and analysis

In the dialogical perspective of heuristic-qualitative school (Kleining, 2007), the process of research can be viewed as turning in dialogical cycles. In regard to the principle of openness towards the research object, new answers always also lead the researcher in the field to new, more elaborated questioning. More elaborate and unexpected conceptual changes require the assessment with different research methods, in respective cycles of the research project. The process of research, thus, can be conceptualised as a dialectic process in the exchange with the research topic, which should allow for an in-depth understanding of the research phenomena. Questioning should allow discovering new aspects and structural elements of the research phenomena, thus, the research process is a process of discovery. The discovery always turns back to the originally stated research object, but with a deeper understanding of the structuring elements. In this field study, a first
orientation towards task oriented processes of collaboration, was changed as work groups could be
discovered, that did not perceive themselves as teams. Therefore, questions changed towards
processes of social categorisation and their interplay with task related information processing in
partially distributed settings. During data analysis more and more social processes were taken into
account of having a contributory role in the development of the understanding of a team. The
cyclical research process was split in four major cycles - the cycle of understanding of the contextual
parameters of the cases, the cycle of in-depth case studies to trace project time lines, a cycle of
comparative analyse between the cases, as well as the cycle of communicative validation and
theoretical development of heuristic propositions (see Table 2: for a summary of the collected data).
In all the cycles, the newly developed understandings were discussed in workshops with the involved
participants of the field study.

Following the principles of heuristic research proposed by Kleining and Witt (2001), the analysis
focused on the identification of similarities varying substantially on contextual parameters of interest
specifically, concerning the insights of the results obtained during the cycles the study concentrated
on similarities regarding the global variables stated in the basic research framework by abstraction of
the differing local dynamics that may evolve in the concrete everyday interaction of the groups under
study. The analysis of similarities occurred at multiple levels between projects within the cases,
across the cases and proceeded in cycles between the primary data and first order abstractions. The
analysis in these cycles was guided through the preliminary stated sensitising research concept
(Blumer, 1954), which was further developed to the sensitising framework throughout the process of
assessment and analysis.
Table 2: Variation of assessed data in the explorative case study

<table>
<thead>
<tr>
<th>Cases</th>
<th>Case 1 CH-IND</th>
<th>Case 2 CH-IND</th>
<th>Case 3 CH-IND</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document analysis</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Contextual interviews (management level)</td>
<td>8 (CH)</td>
<td>4 (CH)</td>
<td>5 (CH)</td>
<td>31</td>
</tr>
<tr>
<td>Teams</td>
<td>2193</td>
<td>2169</td>
<td>2187</td>
<td>1122</td>
</tr>
<tr>
<td>Retrospective interviews</td>
<td>-</td>
<td>1 (CH)</td>
<td>1 (CH)</td>
<td>4 (CH) 2 (CH) 1 (CH) 3 (CH) 2 (CH) 3 (CH)</td>
</tr>
<tr>
<td>of communication dynamics</td>
<td>-</td>
<td>1 (IND)</td>
<td>1 IND)</td>
<td>5 (HR) 2 (HR) 1 (DE) 3 (DE) 2 (DE) 1 (DE)</td>
</tr>
<tr>
<td>Assessment of communication events</td>
<td>2 (CH) -</td>
<td>8 (CH) 9 (CH) 17 (CH) 23 (CH) 12 (CH) - - - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(communication events)</td>
<td>4 (IND)</td>
<td>6 (IND) 16 (IND) 10 (IND) 23 (HR) 8 (HR) - - - -</td>
<td>138 events</td>
<td></td>
</tr>
<tr>
<td>Validation interviews</td>
<td>1 (CH)</td>
<td>1 (CH)</td>
<td>1 (CH)</td>
<td>1 (CH) 1 (CH) 1 (CH) - - - -</td>
</tr>
<tr>
<td>Validation and development phase (participants in workshops)</td>
<td>6 (CH) 8 (CH) 4 (CH)</td>
<td>6 (IND) 8 (HR) 4 (DE)</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>
4.2.2.1 First cycle: contextual analysis of the case

To get an in-depth understanding of the contextual parameters the data collection started with a contextual analysis of the involved business cases. For the investigation of influential contextual parameters actors with considerably differing perspectives were interviewed. Interviews included 30 semi-structured interviews with the management of the involved companies, which lasted from one to two hours. People on the level of project and process management as well as HR and IT-representatives were interviewed. The contextual interviews were partially transcribed. Documents referring to the work organisation in the selected cases were analysed. Additionally, the sites involved in the study were visited by the research partners. This exploratory study of the context of the cases facilitated a better understanding of the task involved in the partially distributed teams, the organisational structure of the collaborations (including process and hierarchical organisation), as well as the defining contextual parameters (see Table 1). The first cycle allowed for a categorisation of contextual parameters, which guided the further theoretical sampling process (Glaser & Strauss, 1967) and data collection.

4.2.2.2 Second cycle: In-depth within case assessment and analysis

The exploratory analysis of the contextual parameters of the involved cases was followed by a retrospective analysis of the structuring of global communication patterns. Eleven projects were chosen as typical for the respective cases under study. The selected projects provided a representation of the everyday structuring of communication and interdependent task work between the sites. To allow a maximum variation of perspectives regarding the understanding of behavioural interdependence over time, project workers as well as leaders from both sites were interviewed in sessions during 45 minutes to one hour. The participants were asked to sketch a prepared graphical model of the team’s communication intensity before the interview. The project life lines were sketched in the interviews in a dialogical process between the researcher and the interviewee (cf. Kleining & Witt, 2001). The sketches represented a reconstruction of the communication processes throughout the whole project. The method of life lines is described by Moldaschl (2009) as a valid method for the assessment of subjective perceptions of process dynamics. The method of project life lines was applied to reconstruct the subjective perception of communication dynamics in the partially distributed teams over the phase of a project. The method can be ascribed to associative methods, as it allows for the reflection of experiences and the dialogical discussion of specific episodes and their defining structures.
The process of inter-subjective understanding between the researcher and the project worker was supported by the creation of the project life line, in terms of the intensity of communication between the sites (see Appendix A for the applied template). The method was used to discuss the influence of critical events in the process and their influence on the structuring of communication dynamics. The interviewees were instructed to sketch the intensity of behavioural interdependence over the whole project. Questions of specification were asked for specific phases in the project as well as concerning unexpected events, when no automatic narrative descriptions of the project episodes occurred (cf. Wiedemann, 1986). This was especially the case for phases of low communication intensity, or so-called implementation or execution episodes (cf. Marks et al., 2001). In a similar vein, Moldaschl (2009) insisted on asking questions of specification not only regarding critical events or phases of higher intensity, but also for phases of inertia or stasis throughout the process. Such phases might be relevant with regard to the global dynamics. The sketched project life lines allowed a structuring and specification of the most important project episodes. They served as a frame in regard to the interview scope. The sketches could be used to reflect connections between specific episodes and the global dynamics in the project.

According to Moldaschl (2009) such a reconstruction of project life lines should be combined with more direct observational methods. To allow a closer insight into the daily structuring of communication episodes, a diary study of communication events was administered during a period of three weeks in selected projects. Because of privacy concerns of the 'Betriebsrat' (workers council) on the German side of the third business case, the diary study could not be conducted there. Following the maxim of perspective variation the events were assessed from project workers as well as project and team leaders perspectives from both sites. Again, the events were discussed with the participants of the diary study in semi-structured interviews. Sketched process charts were reflected and respective narratives of the assessed episodes were interpreted in the interviews.

The analysis of narrative parts of the interviews followed the steps described by Wiedemann (1986). The interview sequences, were first of all, checked regarding their internal validity of narrative sequences, in which the speech of the interviewee was not interrupted by the interviewer, except for questions of understanding, further explications and specifications, open questioning or other methods to enable a narrative sequence.

Following Wiedemann’s (1986) classification, five schemata of interview responses were distinguished to analyse narrative interviews: abstract contextual descriptions, description of emergent team perceptions or states, description of re-occurring typical episodes, reports of routine episode progression and narratives of unexpected episodes. Those types of interviewee responses can be defined by the degree of self-reference the interviewee takes. Statements may be distinguished according to the perspective of the narrator, such as being personally involved or as a
recitation of abstract facts. Furthermore, the degree of personal involvement may be differentiated according to the emotional statements of the interviewee. In a second step interview passages may be distinctive according to their chronological perspective. Diachronic references follow a clear linear progression of natural episodes; whereas in the synchronic perspective everything happens at once and no clear progression is discernible. Diachronic references, therefore, can account for emergent phenomena such as team states (e.g. team identification). Episodes also can be distinguished according to their space-time reference. One can differentiate text passage in interview transcripts depending on their reference to concrete episodes with a certain amount of personal involvement or the reference to typical episodes, which are re-occurring in time. More abstract descriptions of typically re-occurring episodes were discerned from concrete descriptions of actually experienced processes (cf. Marks et al., 2001). Narratives in the strict sense refer only to unexpected episodes, with high amounts of personal involvement and some degree of complication or equivocality (cf. Daft & Macintosh, 1981; Dennis et al., 2008). Reports of routinely progressing episodes were not defined as narratives, but helped to grasp action oriented, routine team and coordination processes. According to the criteria stated by Wiedemann (1986) the following rules for selecting and categorising the text passages in the phase of in-depth case analysis were developed (see Figure 5).

<table>
<thead>
<tr>
<th>criteria for text selection</th>
<th>type of text passage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reference is given</td>
<td>Abstract contextual description</td>
</tr>
<tr>
<td>Diachronic perspective</td>
<td>Description of emergent states</td>
</tr>
<tr>
<td>Singular space-time</td>
<td>Description of typical episodes</td>
</tr>
<tr>
<td>Unexpected, exceptional progression</td>
<td>Report of routine episodes</td>
</tr>
<tr>
<td></td>
<td>Narrative of unexpected episodes</td>
</tr>
</tbody>
</table>

Figure 5 : Decision tree for structuring the interviews (adapted from Wiedemann, 1986, pp. 98)
In a second step of the within case analysis, the referred relations of discerned episodes and the mentioned structural as well as procedural influence factors were analysed. In a dialogical research perspective (cf. Kleining, 2007; Kleining & Witt, 2001), insights of the individual interviews were discussed with the respective team members of the analysed cases in workshops. By involving participants from both sites, events, re-occurring episodes and related processes of social categorisation, which structured the global rhythms of collaboration could be validated communicatively.

4.2.2.3 Third cycle: Grouping of teams according to similarities on the global rhythm
A first level of comparative analysis was obtained by grouping similar trajectories of communication intensity regarding their dynamics and emerging qualities (e.g. team identity). According to Kleining (1982) such a first level groupings can help to develop theoretical propositions regarding observed similarities. Generalisations across systems were enabled by an in-depth analysis of the group's development history as well as initial conditions at the onset of the study. Through the comparative approach of global patterns of dynamics, a generalisation across selected projects was methodologically feasible (cf. Arrow et al., 2000). To check for the reliability of the sensitising concept of interactional intensity over time, different data sources were compared to develop an integrative understanding of the trajectories within the selected projects.

The groupings were refined through comparisons of data sets that contained a certain degree of similarity, compared to other data sets in which differences were predominant. According to Kleining (1982), data can be categorised in different ways according to shared commonalities. New groups emerge out of the data that contain additional idiosyncratic information, which have not been grouped yet. In a next step, those preliminary groupings are again analysed according to their similarities. Differences can be overcome by developing new explaining categories for emergent groupings. Preliminary groupings might be changed, as they now better fit to the re-evaluated data.

It is important to state the respective rules for each change in groupings regarding the interplay of the overarching categories. Such changes are highly relevant as they might indicate emerging structures of the object under study. According to the rule of “100%” stated by Kleining and Witt (2001), at the end of the analysis all the data material should be included in the overarching structure.
Table 3: Grouping of analysed project teams across cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Project</th>
<th>Formalised specification pattern</th>
<th>Review Rhythm</th>
<th>Polyrhythmic pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 1 CH-IND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1122</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2193</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2169</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2187</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>9008*</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Case 2 CH-Cro</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Z2</td>
<td>2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ZIP</td>
<td></td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Case 3 CH-De</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team 5</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team 9</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team 4</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Team 6</td>
<td></td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

I = Number of included persons in the interview study
*project was conducted in a collocated setting in the Swiss OEM

→ perception of a working team/ team identity

Even though some of the projects did not require team work, the data of those projects were integrated into the development of a first order process grouping, which enabled the differentiation of both the important social and the task-oriented processes leading to the perception of team identity (Guzzo & Shea, 1992). In a first step, the process charts were divided according to their trajectories. These first groupings were then presented in a review meeting with all the project partners. In this meeting the partners approved a continued exploration of comparable patterns of communication intensity in the cross-case analysis under consideration. As indicated in chapter 4.2.2.2, the assessment with the short communication questionnaire started. The next step of grouping of process types was done under consideration of the varying data assessed in the research process. Thereby, the interview data of the differing cycles of data assessment and analysis were integrated for the final analysis. The groupings were cross-validated with the sketched project trajectories and the plotted event projections. The analysis resulted in a first order grouping of three different global rhythms of behavioural interdependence (see Table 3). Therefore, the rhythms could be validated for the involved cases, despite the sampling differences in regard to defining contextual parameters of partially distributed teams (see Table 1).
Two team members were not grouped due to a lack of involvement in team processes. For the development of more complex rhythms, the majority of the team had to be integrated into the structuring episodes with the most complex interdependence pattern. Further two members had to be excluded from a more complex polyrhythmic pattern, as they were not involved in early team learning activities. Through the groupings and the across case comparative approach a research framework consistent of categories could be developed which allowed to explain the differences in global communication rhythms by focussing on underlying similarities. The discovery of substantive examples of the two global rhythms of behavioural interdependence over the diverse sample indicates for a saturation of the discovered structures, as the rhythms could completely explain all the data assessed in the explorative research process (rule of 100%; Kleining & Witt, 2001; Kleining, 1982). All the interviews were coded with the qualitative data analysis tool Atlas.ti. The complete interview category scheme and the respective codings in the process related interviews are presented in Appendix B.
4.2.3 Results

The identified global dynamics will respectively be related to discerned contextual enablers and the rhythms will be compared in their internal dynamics of structuring team performance episodes. First theoretical arguments are elaborated, which guided the development of testable hypothesis for the simulation study.

4.2.3.1 The discerned global patterns of behavioural interdependence

Behavioural interdependence over the course of a team's project is reflected in the communication intensity defined by the frequency of communication and the amount of equivocal information processing required. Descriptions of behavioural interdependence rhythms could be found in the narratives explaining the sketched intensity over time. Thereby, metaphorical descriptions of the rhythms such as heart beat, wave or saw teeth forms or flows of information and radiation were often used.

Formalised specification pattern. First of all the team dynamics, in which no interdependence rhythm and consequently no shared team identity on the level of the partially distributed team could develop, will be described. Phases of goal setting and task allocation in all the cases typically could be managed simply by the transmission of required information for the standard tasks; in most of the teams no further elaboration of the data was needed, as the set goals and involved task requirements were clear for the executing party. This resulted in a similar pattern of independent work with asynchronous trajectories of communication intensity for the goal setting compared to the executing party. The pattern is also reflected in quite different patterns sketched by the project leaders for assignment of such tasks. During task execution in some of the cases - especially the Swiss-Indian case - further regular controlling meetings with team leaders were scheduled (e.g. every week). In this pattern those events did not really affect the intensity in the exchange of information, as the Indian engineers just reported the actual state of their work without further discussions or decisions regarding the tasks. Similarly, in most cases the tasks were first checked by the onsite teams and then transmitted to the other location. Mainly the feedback at the end of the task could be transmitted again through formal, predefined feedback documents, for example through a simple email. Under the independent task work conditions mentioned above, the work group in the partially distributed context was not perceived as a team.

The review rhythm. The rhythm can be described as decreasing in behavioural interdependence over time, with re-occurring burst of intensity at the scheduled or planned review meetings. The rhythm was sketched as a decreasing wave like sinus form. Cross-site interdependences were required for specifying and understanding the interdependence structures of the tasks. During task execution the
communication level between the sites was on a rather low level, only occasionally disturbed by spontaneous or also recurrently scheduled meetings for task monitoring. A change was perceived when approaching the prescheduled review meetings. The results have to be gathered for a presentation to respective project stakeholders. A public presentation may be seen as a synchronising structuring event for the global interdependence dynamics, as the decision for upcoming phases of the project is made. The re-specification of tasks again required phases of reciprocal interdependencies for achieving a shared understanding regarding corrective actions and the proceeding for the next project phase. After this phase of reciprocal interdependencies at the end of the reviews, again more silent phases followed. Mostly the projects clustered to these dynamics ended with formal feedbacks to the respective sites, which did not require any intensely interdependent task work processes.

The polyrhythmic pattern. The dynamics in the projects that could be clustered to the polyrhythmic pattern were described as exceptional compared to other projects as the following quote from case one exemplifies: 'Well, ok, this project is a little bit specific for me because the communication is on a much higher level than usual'; 'But here was really live project with lot of ups and downs, so we were more communicating than ever' [sic!]. This pattern followed a trajectory from an intensively interdependent inception phase, simultaneously accompanied by task implementations episodes. Those episodes involved more interdependences between the sites, as well as unpredictable phases of intensive burst of communication intensity in case of cross-site adaptive transitions between the prescheduled review episodes. Compared to the recurring review meeting pattern, the polyrhythmic pattern typically showed an increase in behavioural interdependence in the later project phases in re-occurring team transitions.
4.2.3.2 Contextual enablers of the discerned behavioural interdependence rhythms

In the following, the influence of contextual enablers on the development of global interdependence dynamics, which are prolific to innovative team outcomes will be discussed. The rhythms of behavioural interdependence over time were perceived as being influenced by different contextual enablers. Under the category only the structural aspects, which directly have an impact on the degree of behavioural interdependence over time on the level of the partially distributed teams, were included (see for Table 4 for an overview).

Table 4: Contextual enablers of the discerned global interdependence dynamics

<table>
<thead>
<tr>
<th>Rhythms</th>
<th>Formalised specification</th>
<th>Review Rhythm</th>
<th>Polyrhythm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisational structures</td>
<td>Centralised</td>
<td>Centralised project lead</td>
<td>Decentralised</td>
</tr>
<tr>
<td>Task complexity</td>
<td>Routine tasks</td>
<td>Process ambiguities</td>
<td>Goal and process ambiguities</td>
</tr>
<tr>
<td>Distribution of expertise</td>
<td>Centralised expertise</td>
<td>Centralised core expertise</td>
<td>Distributed expertise</td>
</tr>
<tr>
<td>Task allocation principles</td>
<td>Formalised task allocation</td>
<td>Sequential; component structuring</td>
<td>Parallel goal exploration and implementation</td>
</tr>
<tr>
<td>Leadership diversity beliefs</td>
<td>Differences are perceived to negatively impact standardised coordination processes</td>
<td>Explicit focus on similarities and minimisation of differences</td>
<td>Appreciation of differences and site specific expertise</td>
</tr>
</tbody>
</table>

83
In the environment, the *centralisation of the project organisations* under study was coded. The degree of centralisation is reflected by the location of important decision authorities regarding the projects. In completely decentralised cases the decision authorities are distributed in parity across the sites (e.g. case three). The centralisation of the project authorities also influenced the degree of hierarchy between the sites involved in the project, which can be further accentuated if companies as in case one are suppliers and most importantly are perceived as a pool of additive resources for the projects. Thereby hierarchies also directly effect the behavioural interdependences to occur throughout the project.

On the level of teams, the perception of complexity and equivocality of tasks influences processes of clarification and specification of target goals in the collaboration. If the person responsible in each phase or case perceived ambiguities regarding the goal state, phases of co-construction or transition were required in the beginning of projects. Furthermore, complexity of the task involves also ambiguities in the process of goal achievement, as the following interview example shows: "It's complex in the sense that I think we get the results what we expect or if we would have got the expected results in the initial stage it would not have been this complex." This process aspect of task complexity involves randomness in the requirements for re-establishing a common understanding regarding the actual state of work towards the achievement of set goals. Differing perceptions of task equivocality are thus connected with differing practices of allocating tasks and structuring task interdependences.

First of all, perceived requirements for the reduction of equivocality in the beginning of projects influenced two differing temporal *principles of task allocation*. Therefore, importance of the *temporal structuring* of the reduction of task equivocalities in regard to the development of interdependence dynamics could be shown. The major difference between the re-occurring review rhythm and the polyrhythm was the sequential or parallel structuring of reducing equivocalities throughout the project. In the review and decision rhythm, goal ambiguities were reduced early on in the project in an exclusive expert cycle, producing a clear cut sequential temporal structure between innovative exploration of solutions and implementation. Even if the goals of the projects were perceived as more complex, as for example the radical innovation step in project Z2, a more accentuated sequential structuring could be identified: 'We worked out the details in the very first phase of the project and I recall that reviewers let's say told us that the design in this very first phase was pretty mature'. Allocation of explorative tasks to the expert(s) of the centralised site resulted in less behavioural interdependence between the sites. Such a temporal pattern was structured by recurring review meetings and decreasing behavioural interdependences throughout the project. In the polyrhythmic pattern, the early integration of expert engineers from respective sites in problem understanding and solution generation created the possibility of more parallel structuring of task
interdependence requirements throughout the innovation projects. Therefore, it is assumed here, that an integration of engineers from both sites in early project phases and a more parallel structuring of the reduction of goal equivocalities enabled the development of more complex and adaptive global interdependence dynamics throughout the whole project.

Secondly, the perception of expertise distribution across sites influenced further principles of task allocation. In relation to the perceived task equivocality, the perception of expertise for reducing it, influenced the identified allocation patterns. When no special expertise was perceived to be in place at a specific site, only less complex tasks would be allocated in a formalised and standardised way as described in the formalised specification pattern. In the review rhythm pattern a principle of component structuring could be discerned as typical. So for example, an engineer of the Swiss site in project Z2 mentioned the fact, that ‘when something is outsourced, we try to outsource all the disciplines [names of disciplines] involved to [site in Croatia], so that they communicate directly’. If expertise for constructing a whole component was perceived to be available at one site, specified tasks with a rather low degree of task equivocality were allocated for implementation to the respective sites. In recurring review rhythms, tasks were allocated in a way that site specific subgroups were more or less autonomous in building a machine component during implementation episodes. This was done mainly to prevent long and delayed communications in case of cross-site coordination. Consequently cross-site behavioural interdependences were reduced during task implementation episodes. Therefore, in the review rhythm pattern no intensive interdependences were expected throughout task execution. In the polyrhythmic pattern the perception of the value of cross-site expertise for respective reduction of equivocalities, lead to a high level of behavioural interdependence throughout the projects. The equal distribution and the subjective evaluation of the expertise of involved team members from different sites by respective leaders had a strong influence on the amount of intensive interdependences that occurred throughout the project.

On the individual level in interplay with the distribution of expertise, the perception of the function of diversity communicated and enacted by project leaders was coded as an influencing contextual variable. Thereby, all aspects of the leadership style which imply beliefs and attitudes towards the effects of diversity on the team collaboration were coded. This rather indirect coding of the beliefs via leadership styles was chosen because of receiving socially desired answers when asking explicitly for such beliefs in the interviews. Differences could be observed regarding the importance that the leaders attributed to mutual learning in diverse teams thereby influencing the beliefs and attitudes towards diversity. For example, in team No. 6 the team leader from the site in Germany was really glad to benefit from the insights of the Swiss team members as they helped him to do a better job at his site. Thus, he fostered the harmonisation initiative and enabled highly motivated people by giving them the required autonomy and respective resources. Furthermore, differences were also
perceived during unexpected episode progression, or in case of conflicts, when the processing capacity of involved leaders was on a lower level. A big difference was identified between leaders in case two, for example the project leader in project Z2 had a tendency to rather minimise cultural differences when explicitly stated and perceived them as problematic in case of project reviews. During reviews differences became salient because they negatively interacted with the goal of alignment. In contrast to it the leader of the project ZIP framed the different sites as providing different experiences and expertise for solving technical problems. Thereby, an open exchange of ideas on the level of the partially distributed team was fostered. Similarly in case one differing project leader’s perception of diversity influenced the collaboration process. For example, in project 9008 the team leader showed a high amount of intercultural experience and was motivated to work with people from different cultural backgrounds. Furthermore, he appreciated the programming expertise brought in by the Indian engineer for this project. This created a positive perception of diversity regarding informational task contributions. Consequently, such positive perceptions of the influence of diversity had an effect on the patterns of global task interdependence.
4.2.3.3 Local dynamics in the team performance episodes of the discerned rhythms

Global rhythm of behavioural interdependence over the course of a team's project involves contextual and internal structuring in team performance episodes. The discerned patterns of behavioural interdependence were structured by specific team performance episodes. The following episodes could be differentiated between task implementation or execution episodes, review meeting episodes and transitive team learning episodes.

In task implementation or action episodes the goals are set, and the main purpose is to execute the task effectively. Therefore, it is required that involved team members share an understanding of the task purpose and the means to achieve them, to coordinate required interdependences in the process. Task work processes, such as task clarification and understanding, continuous coordination and feedback structure the interdependences in the process of execution depending on the requirements of the task and the team's rhythm of behavioural interdependence. Such coordinative task work processes are occurring when tasks can proceed according to the scheduled plan and no specific interruptions interfere with the routine of task execution.

Review episodes serve the goal of adjustment in terms of a pre-set goal state in front of a public of relevant stakeholders. They structure the rhythm of behavioural interdependence respectively as they represent specific events for the involved teams with requirements for task work processes relating to the preparation of respective presentations by presenting the core of the achieved goals in a comprehensive manner and making corrective adjustments. Interdependent and synchronous interactions are required for reflexive questioning of the goal state at a prescheduled time point in the project. Cooperative processes are defined by external or internal dynamics, which require a certain degree of equivocality reduction and adaption regarding the planned work process. The higher amount of equivocal information in terms of possible solutions requires collaborative and synchronous processes to come to a shared understanding regarding the further proceeding in the project. The identified global interdependence rhythms incorporated similar team performance episodes, with increasing degrees of interdependent, cooperative processes on the level of the partially distributed team (see Table 5).

Besides episodes that are occurring according to plan, episodes structured by unexpected dynamics could be discerned. So-called transitive team learning episodes are structured by unexpected dynamics in the context of the partially distributed team. The dynamics might be caused by internal changes, for example through the development of new ideas by individual members or by external changes. Unexpected dynamics require a questioning of the respective goal space as well as the means to achieve respective goals. Thereby, reflexive communication and cooperative processes become necessary. On the level of task work processes they require a shared and situated attention
of the changes in the actual goal state, the explorative search for possible solutions, an early evaluation of the solutions and decisions regarding the further proceeding in the project.

Table 5: Task work episodes, social categorisation and emergent states

<table>
<thead>
<tr>
<th>Episodes</th>
<th>Implementation episode</th>
<th>Decision and review episode</th>
<th>Problem solving episode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process variables</td>
<td>Implementation episode</td>
<td>Decision and review episode</td>
<td>Problem solving episode</td>
</tr>
<tr>
<td></td>
<td>Contextual information integration</td>
<td>Situated attention towards innovation objectives</td>
<td>Problem space exploration</td>
</tr>
<tr>
<td></td>
<td>Early solution evaluation</td>
<td>Processes of de-categorization</td>
<td>Inclusive social processes</td>
</tr>
<tr>
<td>Task work processes</td>
<td>Socialisation to coordination rules</td>
<td>Processes of social inclusion and re-categorisation</td>
<td>Inclusive social processes</td>
</tr>
<tr>
<td>Team perception</td>
<td>Shared understanding of task norms and rules</td>
<td>Shared identification with the project aims</td>
<td>Trustful and participative, psychologically safe team climate</td>
</tr>
</tbody>
</table>

Required task interdependences in the task work episodes and the respective process steps differed according to the global interdependence rhythm. To allow for innovative team outputs in the polyrhythmic pattern all three team performance episodes required task interdependences on the team level. Task-related processes were closely coupled with processes of social exclusion, inclusion and categorisation, which can be recognised by the way people perceive differences between the team members and react to each other’s differences. Learning to know each other was important for
de-categorising the identification with the site-specific subteams. Processes of inclusion could be
categorised under processes of re-categorisation which helped to develop an overarching
identification with the project teams' under study. In contrast to those processes, which weakened
the identification with the site specific teams and enabled the development of the identification with
the partially distributed teams, processes that reinforced the site specific subteam identifications
were differentiated. In such processes the perception of difference did have negative connotations
and was often related to conflicts in the teams. Shared team perceptions emerged from the
interdependent task-related processes and processes of social categorisation within the structuring
team performance episodes. For assessing team identity emotional disclaimers such as in 'our team',
'we', 'if felt as a member of this team'; 'whole group was on the line'; 'You're more the member of a
team' were coded. Statements regarding the integration of the groups or differentiation between
site specific teams were coded as well. Furthermore, differing intensities and rhythmic re-occurrence
of intensities over the course of the project influenced specific outputs, such as team identity as well
as the degree of innovativeness of the projects output.

**Structuring review episodes in the recurring meeting rhythm**

In the recurring review rhythm, the working engineers were not involved in the transitive cooperative
phase of creating an early understanding of the innovation goals. In the implementation episodes,
the process of task specification and understanding required a higher degree of autonomy in defining
required interdependences between different departments in episodes of task implementation. Bi-
directional communication between the members from both sites was required in task work
specification and understanding processes. Therefore, as starting trigger into the project, the
working engineers had to learn to anticipate interdependences inherent in the task. Such early
adaptive cooperation processes also confer the partially distributed teams the ability to correctively
adapt their task work plans in problem solving episodes when unexpected events require it.
Transitive team learning episodes in the recurring review rhythm were limited to the adaptation
plans, as the following substantive example shows: 'we somehow get unexpected delay of three
month I think, a delay of produced [component] and based on this we need to realign the production,
other production steps, you know.' Effective adaptation processes in combination with the
predominant principle of whole component task allocation to respective sites resulted in more or
less independent work during in implementation episodes. Tasks could be coordinated by constantly
exchanging boundary conditions both in scheduled and more informal or implicit processes of
continuous coordination.
Review episodes. Those episodes required the shared orientation towards predefined goals in processes of gathering the results, as well and most importantly during presentations in front of relevant project stakeholders. It was a usual practice to collocate experts from both sites during review episodes, as the process of alignment in respect to the pre-set goals required synchronous cooperation between the subgroups at the differing sites. Those meetings were perceived as highly demanding in regard to goal alignment: 'Yes, the review time is...yeah, it is very, very intense, let’s say, which is due to activities to communication. We need to align a lot of reports'. The actual review meetings represented such a phase of cooperation, during which the actually achieved goal state had to be re-evaluated in front of the external experts. The reviewers were allowed to assign appropriate corrective actions. In the case of recurring review rhythms those actions were handled within the pre-specified goal space involving adaptations regarding solutions implementation or regarding the project plans and schedules.

It is proposed here that the scheduled review events represent goal evaluations in front of external stakeholders. Such cooperative processes of readjustment require synchronous interaction in f2f-settings for creating the orientation or alignment towards the shared innovation object. Review meetings involved the evaluation of the achieved results and the anticipation of the expected proceeding in the project to achieve set objectives. In the recurring review rhythm such adaptations were limited to the adjustments of behavioural scripts or means to achieve the pre-established goals, which were defined in the centralised, site specific expert teams in the beginning of the projects.

Instable identity dynamics in the recurring review rhythm

In the review rhythm an unstable identity dynamic has been identified. The clear demarcation of site specific teams could be differentiated from a perception of an association to the overarching, partially distributed team. Team identity could not be described as stable, as the identification changed between the site specific subgroups in less interdependent, implementation episodes, and the partially distributed team in highly interdependent review and decision episodes. The following interview excerpt reflects on the ambiguity and instable balance between the identification with the partially distributed team:

In [site in Croatia] we...it was not only the team, like all the teams who were working on this project. At that time they were on this meeting. Like not only we from [discipline A] but also from [discipline B] and the one guy from [discipline C] who participate in [site in Croatia]. All the other guys in [site in Switzerland]. That’s a nice team.
It shows that the stronger association with a ‘we’ as an emotional identity disclaimer is felt towards the site specific team. This unstable dynamic was reinforced in the implementation as well as in the review episodes. First of all, in the very first episodes of task clarification and understanding, the partially distributed teams had to develop some kind of shared work orientation to coordinate interdependent tasks. This required the development of shared norms and rules for interdependent coordination processes. Because of rather low levels of interdependence throughout the implementation episodes, however, work processes were often still strongly oriented towards the site specific organisational culture. Low levels of interdependencies during continuous coordination and the requirements for adapting in case of unexpected dynamics or when reviews were approaching, led to an unstable dynamic regarding the shared perception of required norms for coordinating boundary spanning work. Conflicts were identified, in which differences for example in regard to documentation practices clashed when preparing reviews. Such conflicts were caused by site specific work routines and standards, which shaped the work and coordination in the site-specific subteams.

Secondly, the unstable identity dynamic was reinforced in the highly interdependent episodes of review meetings. The pattern of work for preparing reviews was described by a Croatian interviewee: ‘So for us, little bit less experienced, the task is maybe each day just to think about how to solve the problem and then go to the experts and work it out.’ Even though, by inviting experts to the review, efforts of social integration in the overarching process were undertaken. A clear cut, mostly site specific differentiation of experts and non-experts, increased the demarcations between the sites. Therefore, engineers from decentral sites did not completely identify with the goals of the innovation endeavour. In accordance with the assessed team innovations, it is assumed here, that for partially distributed teams the sequential and exclusive review rhythm did not result in effective implementation of innovative outputs on the level of the partially distributed team. The instable balance between site-specific identification in task implementation episodes and the demarcation pattern in highly interdependent review episodes resulted in identity conflicts, which did not facilitate innovative adjustment of the goal space throughout the innovation endeavour.

**Transitive team learning episodes as structuring element of the polyrhythmic pattern**

A first similarity relating to the project teams in *polyrhythmic pattern* was that all teams experienced an episode of *transitive team learning*, which transcended the location boundaries early in their teams’ life. For example, in the project ZIP in case two, such an episode was triggered by equivocal information of a component that showed a lot of deficiencies in the field. The problem of the component was brought in by the service organisation partially seated in Florida and required the integration of contextual machine information. In a similar vein, in team No. 4 in case three differing
results of specialised quality tests required the integration of divergent contextual information from the production lines. In the polyrhythmic pattern the task work process in most of the cases started with a brainstorming meeting. Such synchronous brainstorming meetings facilitated a collectively shared attention and a first understanding of shared objectives. This early understanding structured the further collaboration in the sense of a participative and collaborative search for creative ideas and technical problem solving.

After establishing a first understanding of the problem, an explorative parallel processing of various possibilities and solutions was triggered. Ambiguous information from the external context acted as a trigger for a participative process of transition, in which efforts were taken to understand the project aims:

> Because we have just results from side, we have a lot breaking this component there was, you know the welding are broken, so there was defect... So in the beginning we have some time, one or two weeks, we were just overwhelmed with a lot of information so we just need to go in one direction, you know.

High degrees of contextual information ambiguities required reduction in intensively interdependent episodes of transitive team learning to create more clarity regarding possible solutions. In team No. 6 the importance to spread the problem and widen the understanding by involving appropriate experts was perceived as critical. Thereby, the open structures of the differing harmonisation teams promoted the access to distributed expertise across sites. Consequently, smaller problem-oriented groups formed, which processed possible solutions to the problem. Such a parallel process of creating early solutions was described by an engineer as chaotic and intensive:

> it was the first month maybe a little bit chaotic because we don't really know what to do, in which direction to go, there are too many times too many directions you can go [...]. So there was just in the beginning lots of ideas we need to create.

Such problem exploration processes were described as parallel processes in subgroups that had to exchange preliminary results of proposed solutions. Such processes of exploration required the reciprocal exchange of early ideas and evoked evaluations of the proposed solutions. Early evaluations required intensive interdependencies to achieve a shared understanding of the proposed solutions between the sites with daily communications over phone and web conferences. Possibilities of application sharing to share first sketches and models were widely-used in such meetings. Sometimes the engineers were simply co-located for a longer project phase to the other
site for enabling a more rapid switch between the parallel exploration of ideas and early evaluations. During such creative transitive team learning episodes time was perceived to not really advance:

So, we here, we find ourselves on the beginning like we are doing nothing on the first month. But slowly, from time to time, we get some ideas...but maybe after two months, three months we have maybe two or three possible solutions, for which we decided to go there, in this direction.

After the production of differing possible solutions, and their early evaluation, a decision has to be taken. With this early narrowing down of the solution space the tasks for the next phase could be specified. Such transitive team learning episodes did simultaneously engender early task implementation episodes, which were structured by a higher level of cross-site task interdependences.

At least in project Z2 and the team No. 6 a clearly accentuated burst of intense task-related interdependence could be observed towards the end of the involved projects. Those episodes of transitive team learning were often caused by internal dynamics for example through identification of new ideas of how to approach the problem as in the case of project ZIP. In case of internal dynamics for example caused by ideas, which have been developed by individual engineers or subteams it was critical to directly communicate such ideas to the members in the partially distributed team:

there are some sorts of some ideas that come across, which you maybe need to have sketched right to the moment, you have a piece of paper and a pen and draw something. It's always easier when you have discussions like that, to do it right on time.

The high behavioural interdependences through frequent prescheduled meetings enabled the identification of such ambiguities. In later stages of the projects often equivocal information was identified at external sites such as suppliers (e.g. team No. 6 case three), or at test centers (e.g. project 2187 in case one). In the case of team No. 6 this f2f encounters were directly held at the supplier site, to get a contextual understanding of the problems that occurred. The process of creating a contextual awareness of problems was followed up by an exploration of solutions, which started directly at the site and then engendered intensive discussions for evaluating solutions often in collocated settings.

Solutions that were developed consequently were perceived to be more innovative than the
solutions under the review rhythm. For example, the solution in project ZIP was patented and - as the post assessment shows - is now running effectively on several engines in the field. This solution could reach a higher market impact than the solution in the parallel project and planned radical innovation step in project Z2. Similarly, in team No. 6 of case three at the end of the project a really complicated optical inspection evaluation process could be harmonised between the sites. This process enabled similar quality outputs from both machines in spite of the respective differences in the production lines. The innovative solution for the quality inspection process is now widely distributed in other product lines at both sites. Also the software developed in project 9008, could be presented in a European research project, and is widely dispersed throughout the company. It is assumed that the early episodes of transitive team learning enabled the teams to create innovative solutions in late project phases.

Processes of de-categorisation, emergent open, trustful climate and the development of a stable team identity in polyrhythmic pattern

As the examples from the team learning above show, there was a strong accentuation of involving the engineers from the differing sites in goal related elaborations already in an early project stage. Early collocations of engineers to the respective sites fostered the development of personal relationships. The experts in team No. 6 also met on external occasions, such as conferences on respective topics, which enabled the development of interpersonal relationships. In a similar way, in project 9008 the close and daily f2f contact between the collocated Indian engineer and the Swiss task leader enabled an open climate, which according to the Swiss task owner could only emerge through close and spontaneous exchanges. For a younger engineer in project ZIP the long-term collocation in the project enabled him to gain security in the exchanges with the engineer at the central engineering hub in Switzerland: 'But slowly step by step you are going into this and people are there to help you, so you find security'. This security also led to more critical perceptions of the contributions of the experts from the Swiss site. Thereby, formerly perceived hierarchical relationships were flattened. The development of personal relationships enabled the perception of respective expertise of the involved team members from both sites. Through the appreciation of expertise a critical and constructive exchange and elaboration of goal and means-related information was enabled. Thereby, critical and constructive problem explorations were fostered and both sites were enabled to learn from their respective perspectives.

A special role in the process has to be attributed to the team and project leaders in the cases clustered to this pattern. For example in team No. 6 the leader gave the freedom and also required resources to the experts on optical inspection of the machine to define their shared goals in the harmonisation of the production process with the new machine. Therefore, their expertise for the
respective machining process was taken in account and the problem defining process could be started between equally motivated and experienced engineers at both sites. Similarly in project ZIP, the role of the project leader was perceived as decisive for creating an open and trustful atmosphere in the cooperative episodes. The efforts of the leadership were thereby received and led to the perception that openness was the way of communicating in the project: ‘You just need to be open too and you don’t need to have some fear to ask anybody for anything really, and we have such kind of approach here’.

Besides the development of an open team climate the definition of cross-site expertise functions encouraged engineers from both sites to contribute during brainstorming sessions and solution evaluation discussions, fostering open, but also critical contributions from both sites. The interpersonal relationships developed also enabled to overcome respective differences in debates about the most suitable solution. Therefore, the openness regarding issues and problems could foster a shared focussed awareness of problems through open contribution and participation.

For the simultaneous implementation episodes, long-term collocation was mentioned as being important for learning the respective norms and rules of collaboration. From the side of the Croatian engineers it was evaluated to be important to get included in the communication loops to really being a part of this team throughout the implementation episodes. In the review episodes the aspect of inclusive informal processes was accentuated. In project ZIP, it was reinforced by letting the responsible person present the results of their work packages at the review presentations. Therefore, the shared presentation of the results to the project organisation increased the identification with the early co-constructed goals of the partially distributed team. That pattern was also identified in the project 9008, when the preliminary results could be publically presented to members of an external research project. This forced the task owner and performer in this setting to represent their results in unity. Furthermore, the intensive phases in preparing and post-processing the reviews with possibilities for informal interaction enabled team development. The team leaders made efforts to create a familiar atmosphere for example by organising special dinners with the intent to strengthen the team’s identity.

An inclusive approach throughout the project enabled the development of a stable identification with the aims and the members of the partially distributed team. This strong perception of the team is reflected in statements of the interviewees ‘I think for this project we had very, very good team’; ‘Whole group was on the line’ ‘there was a strong momentum in this team’ ‘With this team we work on a very special topic’ ‘in this area we have a really grown up team’. It is proposed here, that this perception of being part of a special project team and the development of a strong identification with it, resulted partly through interpersonal involvement in the highly interdependent episodes, but
also as a result of effective inclusive socialisation processes during less interdependent implementation episodes.

4.2.4 Discussion of the explorative qualitative study

In addition to the characteristics of structural task interdependence identified by Wageman (2001), the aspects of temporal structuring and the perception of the distribution of expertise influenced respective global interdependence dynamics. Related to the organisational centralisation of the overall innovation process (Mendez, 2003; von Zedwitz & Gassmann, 2002; Zeschky et al., 2014), the involvement of dispersed team members in early processes of equivocality reduction critically influenced team innovation (Daft & Macintosh, 1981).

In relation to the perception of the distributed competences in partially distributed settings, different types of task allocations could be identified. A pattern in which only tasks with lower levels of complexity were assigned to the dispersed sites could be distinguished. The allocation of tasks which did not require interdependencies on the level of the distributed team lead to a dynamic, which did not engender team work and a shared team identity. Another pattern of whole component task structuring was observed. Such structures lead to a dynamic of low behavioural interdependences during implementation episodes, with respective conflicts for aligning the results at the review meetings. Compared to the studies on faultline teams and the effect of task interdependence (cf. Rico et al., 2012; Voida, Bos, Olson, Olson, & Dunning, 2012), in these teams negative subgroups dynamics were reinforced, which lead to a conflict laden, instable identity dynamic. Such subgroup dynamics impeded a further elaboration of task-related information throughout the projects. Furthermore, a type of more interdependent structuring of tasks across sites also during implementation episodes could be distinguished. Thus, in connection to studies on task interdependence in faultline teams (cf. Rico et al., 2012; Voida, Bos, Olson, Olson, & Dunning, 2012), it can be assumed that structuring task interdependences across sites enables team dynamics, which allows for innovative outputs, when required competences are distributed across the sites.

This effect was reinforced by leaders’ beliefs of the impact of diversity on innovative team outputs that are related to their framing and perception of tasks. If team leaders perceive task-related equivocality (Daft & Macintosh, 1981) to be somehow referred to relevant aspects of cultural diversity, they are more likely to structure task interdependences in a way that such equivocalties can be negotiated. Therefore, the aspects of diversity beliefs are linked with the structuring of task interdependences (cf. Ely & Thomas, 2001). If required competences and expertise are perceived to be available merely in the centralised organisation, the more complex, innovative tasks are allocated to centralised expert teams. This pattern of task allocation resulted in a more sequential global
pattern of the innovation process (cf. Bledow et al., 2009), in which equivocalities had to be resolved in the very beginning of projects by centralised expert teams. Respective work packages which were allocated to dispersed sites, had already been clearly defined and could be transmitted through more formal and standardised communication forms (cf. van de Ven et al., 1976). Such a sequential pattern implied that in the more downstream R&D activities referential changes in regard to the pre-defined goals were not expected (cf. Mendez, 2003). In contrast, when expertise was perceived to be distributed across sites, experts were integrated in early phases of equivocality reduction (Daft & Macintosh, 1981). The structuring of interdependent task in an early phase of the innovation project enabled more complex interdependence dynamics on the level of the partially distributed team. Such a principle of distributing highly interdependent tasks across sites resulted in a more complex global rhythm of interdependence, allowing for changes and transitions throughout the whole process of innovation.

Therefore, the relationship between the innovative team outputs and behavioural interdependences in the process of task work can be described as increasing in complexity. More complex tasks with respective goal equivocality require early participative and reflexive communication as starting trigger. So-called reflexive communication processes (Engeström, 1992), in which the goal as well as the means space has to be questioned, were required to generate creative, but realistic solutions (cf. Janssens & Brett, 2006). Such processes were based on synchronously interdependent interactions in most of the cases in f2f-settings (Dennis et al., 2008). This allowed the experts in the partially distributed teams to make sense of involved equivocalities (Daft & Macintosh, 1981). Those synchronous events structured the global rhythms in the polyrhythmic pattern, as they implied the adaptation to external or internal changes in the partially distributed teams. Reflexive interaction was best supported in shared f2f-contexts, which directly enabled the contextual understanding. In such events the partially distributed teams' purpose had the time to emerge through the co-presence of relevant expertise. To create innovative team outputs in a partially distributed setting, it is proposed here that interdependence dynamics of higher order complexity have to be learned in transitive team learning episodes in the beginning of a team's life.

Early synchronous cooperation processes (Engeström, 1992) should result in a shared understanding of the innovation objective to trigger the parallel exploration of possibilities for improvement and understanding of the goals and respective means for coming to grasp with the identified issue. Such processes were handled in parallel by interdependent subgroups which cross-cut site specific affiliations. Furthermore, the development of first ideas and solutions required early simultaneous evaluations in a cross-site setting mostly supported by synchronous conference facilities. Therefore, early problem solving episodes required highly intense interdependence structures for the participative development of an understanding of the innovation purpose. It is proposed here that
highly adaptive, open interdependence structures had to be created in the beginning to adapt to the changing contextual conditions (cf. Arrow et al., 2000).

For enabling the development of more dynamic interdependences, a de-categorisation (Gaertner & Dovidio, 2000) of site-specific identification characteristics in extensive transitive team learning episodes was observed. Possibilities for meeting the experts from the other site in f2f-settings allowed for the situated and synchronous understanding of the problem. In the same time they created room for informal communication on an interpersonal level allowing the people from each site to learn from each other on a personal level. This personalisation is described in the common ingroup identity model (Gaertner & Dovidio, 2000) as the first step to perceive the persons from the respective cultural group not only as stereotypical representatives but as a person with distinct and relevant opinions. The recognition of specific knowledge and expertise allowed for a broader understanding of the problem at hand and enabled the development of an open goal definition in an early phase of the project. Early team learning episodes were coupled with processes of de-emphasising the site specific identification patterns.

Important for the structuring transitive team learning episodes in the discerned polyrhythms was the development of an open and participative climate, in which the diversity of expertise of involved engineers from the different sites was appreciated. Such a climate can be an be compared to tacit beliefs as operationalised by Edmondson (1999) in a psychologically safe team climate. An open and participative team climate can be defined as sharing tacit beliefs. A climate in this sense is an emergent state (cf. Ilgen et al., 2005; LePine et al., 2008), established on the ground of the perception of structural characteristics, such as the structural interdependence settings, as well as the actually occurring task and other team related processes (cf. James & Jones, 1974; James et al., 2008; Schneider, Ehrhart, & Macey, 2012). Such climates have been shown to attenuate negative effects of global distribution on innovation processes (Gibson & Gibbs, 2006). Furthermore, a psychological safe climate was shown as important mediator variable of supportive structures on team performance in R&D projects (Bresman & Zellmer-Bruhn, 2013). According to the results of the qualitative, heuristic study a safe participatory climate emerges from the perception structurally interdependent task and on the coupling of reflexive cooperation processes (Engeström, 1992) with processes of social de-categorisation (Gaertner & Dovidio, 2000) required to create a shared goal orientation.

More specifically, the perception of an inclusive climate emerged through the support of the respective leaders, which gave an effort to integrate people from both sites to partake in team learning episodes. Corresponding with studies (Detert & Burris, 2007; Walumbwa & Schaubroeck, 2009), which show the importance of the leader's role in creating participative climates, the interviewees mentioned the importance of leaders engagement for inclusive participation. To
provide respective time and travel resources and efforts made by leaders to create environments, in which the distributed expert engineers were enabled to express their thoughts and opinions, was critical for the experiences of participative and cooperative learning processes. Through extensive support and integration in team learning episodes, a communication climate fostering the development of creative ideas and respective, team learning activities could be fostered. The identified emergent team climate acted as a propensity for future, reflective explorative information elaboration and team learning behaviours to occur, which in turn fostered innovative team outputs.

The theoretical propositions were explored and identified in partially distributed teams in three cases with differing degrees of goal interdependences, respective organisational structures, and innovative aims (see Table 1). Therefore, the proposed theoretical relationships in terms of enabling team innovation in partially distributed, global settings are proposed to be valid in such diverse fields of innovation and different forms of organisational structures. But those explorative findings should be tested in further empirical studies. One first step was made with the experimental simulation, which follows in this thesis.
4.3 Experimental simulation: Indirect and conditional effects of structural task interdependence on team innovation

This second study, aimed at further exploring the structural and process related factors, which enable the development of innovation in partially distributed settings, a simulation study with student teams was conducted. Team work process enablers, on more complex tasks, requiring interdependent task work processes, should be studied in more detail (cf. Arrow et al., 2000). Therefore, a collaborative task setting was conceptualised. The setting should allow for the perception of relevant differences in the respective environments, to learn from each other's differing cultural backgrounds, and for the identification of overarching similarities for developing integrative concepts (Janssens & Brett, 2006). The inherent differences in meanings and understandings regarding the topics in the cultural contexts thereby involved a relatively high amount of equivocality (Daft & Macintosh, 1981) with respective interdependence requirements for boundary spanning team work. The purpose of the study was to find out, whether partially distributed teams would be able to develop innovative team outputs in the relatively short time of seven weeks. According to the findings of the explorative study, conditional effects of structural task interdependence on team innovation on the following process mediators were analysed:

- Processes of information elaboration
- Processes of social categorisation
- The interplay between information elaboration and social categorisation processes
- Emergent team perceptions.

In the following paragraphs hypotheses from theory and the exploration of results from the first study will be deduced, the methodology of the simulation experiment described, as well as the focal results presented and discussed, reflecting on limitations and theoretical implications.
4.3.1 Theoretical development of hypotheses

In the explorative structural forms of task interdependence on innovative team outputs especially in early team work episodes could be identified as success critical factor. The effects were stable across the different forms of structural goal interdependences in the selected cases. As outlined in the theory section (see chapter 2.2.5), it has to be differentiated between the structural forms of goal and task interdependence (cf. Wageman, 2001), as both have the ability to influence the actually occurring behavioural interdependence while working on a team task. Results regarding the influence of different types of interdependence on team innovation led to inconclusive findings. A meta-analysis conducted by Hülsheger, Anderson and Salgado (2009) studied the effects of structural factors, such as interdependences on team innovation. The results of the meta-analytical study indicated possible context dependent effects in terms of the type of teams and study design (experimental vs. field studies). Thus, in the following paragraphs studies on the effects of structural interdependences in distributed or culturally diverse teams - especially in contextually distributed faultline settings (Thatcher & Patel, 2012) - will be reviewed. The insights of the explorative study will be reflected based on this review.

In the simulation study, cooperative goal interdependence was held constant to check for the discriminatory effects of structural task interdependence (Wageman, 2001) on the development of innovative team outputs. Mirroring the results from the explorative study, it was assumed that under conditions of cooperative goal interdependence (Johnson & Johnson, 2005) increasing task interdependences leads to higher levels of team innovation. For the simulation experiment it was hypothesised that under similar cooperative outcome interdependence conditions, teams with interdependent tasks from the beginning of the project involving an early episode of a shared definition of goals and task requirements (Marks et al., 2001), produce more innovative team outputs than teams with lower degrees of task interdependence.
4.3.1.1 Indirect effects of structural task interdependence

On the level of team processes the meta-analysis conducted by Hulsheger et al. (2009) showed that mainly communication, and to a higher degree communication with external persons, lead to innovative outputs in teams. This indicates that the processing and adaption of external information allows teams to innovate, as was the case in the polyrhythmic interdependence patterns of the explorative study. Teams were enabled to adapt and learn according to perceived challenges or problems in the environment. Such adaption behaviour was created through reflexive communication and elaboration of goal and task-related, often contextually embedded, information in early transitive team work episodes.

In the explorative qualitative study information elaboration was structurally enabled through interdependent tasks, which cross-cut location based role structures from the very start of the project (cf. Bettencourt et al., 2007). Furthermore, the findings of the explorative study indicate that an early integration in the definition of goals and task requirements in interdependent task settings, dividing task roles across location boundaries, enables such teams to develop capabilities for adapting to new situations and to respectively learn on a team level, thus leading to innovative team outcomes.

As shown in a field study by de Dreu (2007), the influence of cooperative outcome interdependence and task reflexivity on task performance is mediated by team learning processes. From this line of research, it can be argued that actual team learning behaviours including reflexion and adaption (Wiedow & Konradt, 2011) may be the better process predictor than information sharing for more complex non-routine tasks. In the explorative cross-case study, early intensive phases of transitive team learning were often coupled with short or longer term collocation of central engineers, enabling the development of an inclusive and participative climate.

Team psychological safety as a team climate variable, according to Edmondson (1999, pp. 355), should develop because members of a team perceive similar structural influence factors, as well as share similar salient experiences in the team’s interaction process. In the qualitative follow-up interviews of her study, she explored positive relationships between team learning and task interdependences. The results indicate that a team climate, supporting learning, and risk taking is related to higher task interdependence. In contrast, teams with low degrees of learning behaviours showed a certain lack of behavioural interdependence between team members. This can be taken as indication for a positive relationship between task interdependence and a psychologically safe team climate. Edmondson (1999) studied established teams (functional teams, self-managed teams, R&D teams) with a shared history of collaboration. Whereas in the simulation experiment, the students formed ad-hoc task force teams that never had the opportunity to work together before. By
examining task force teams the influence of structural task interdependence on the development of a psychologically safe team climate is studied.

The question arising for ad-hoc teams is whether the occurrence of collective learning is a requirement for the development of a more stable team climate. If so, it will support risk taking and learning in subsequent processes. For example, the positive experience of taking the risk of talking about critical topics in one's own work context enables a shared problem understanding and can in turn support the development of a climate, which is affirmative for risk taking in the team. Team climates that enable risk taking have been shown to mitigate the negative effects on innovation in distributed teams (see Edmondson & Lei, 2014 for an extensive review). In a field study, Gibson and Gibbs (2006) demonstrated, that in 56 virtual teams the negative effects of geographic dispersion, dynamic structural arrangement, and changing structures or cultural diversity on team innovation could be mitigated when a psychologically safe team climate was established. The cross-sectional design of their field study did not allow for answering questions regarding the development of a psychologically safe communication climate over time. Thus, in the simulation study the exploratory hypothesis regarding the influence of task interdependence and information elaboration for the development of such a team climate will be tested. Team level information elaboration and learning is assumed to be self-reinforcing. Collective information elaboration will lead to a team climate, which in turn fosters further learning and risk taking (cf. Edmonson, 1999). Therefore, it is hypothesised that task interdependence should foster concrete information elaboration in the teams, such as bringing in new ideas or discussing issues, which lead the team members to think more thoroughly about the task. The experience of such learning behaviours should enable the emergence of a team climate that engenders a propensity for further risk taking and learning behaviours in the team, resulting in more innovative team outputs.

Hypothesis 1: The main effect of task interdependence is mediated first by more elaborate processing of task-related information, which in turn engenders the emergence of a psychologically safe team climate, resulting in team outputs with a higher level of innovativeness.
4.3.1.2 Conditional (indirect) effects of task interdependence on team identification

As pointed out by van Knippenberg, Haslam and Platow (2003, cit. in van Knippenberg et al., 2004), the impact of diversity on a specific demographic characteristic depends on the beliefs of the group members, that this characteristic is relevant to the group task. As was shown in the explorative study, diversity characteristics that were framed to be relevant for the group's task positively influenced the development of a superordinate team category. In a similar vein, a study by van Dick et al. (2009) found that the perceived importance of intergroup contact can be seen as the best predictor of prejudice reduction. A study by Adesokan et al. (2011) showed that the effect of negative beliefs on prejudice is moderated by intergroup contact. This is effect is stronger when individual group members perceive their intergroup contacts as important. Task interdependence could heighten the importance of intergroup contacts in work settings and reduce intergroup bias and differentiation. This reduction in turn may enable the development of a superordinate team identity, especially in groups, which hold pro-similarity beliefs.

Motivated elaboration of task-related information can be interrupted by the possibility of forming subgroups along demographic and ethnic lines (cf. Meyer & Schermuly, 2012). The perception of diversity in work groups, is influenced by beliefs regarding the impact of diversity on the functioning of work groups. Within the categorisation-elaboration model (van Knippenberg et al., 2004), team identification is perceived as an affective reaction to diversity in the composition of work groups. Therefore, similar to the results of studies concerning prejudice in interpersonal contacts (Hodson, 2011), it is assumed that in teams with members holding negative diversity beliefs, the possibility for intergroup contact would reduce intergroup bias. In the experiment at hand, the intergroup contact can be seen as instrumental for the achievement of set group goals. Thus, the contact experience should produce a less stringent demarcation between the involved subgroups and allow for the development of a superordinate identification within the partially distributed team. It was hypothesised that the effect of task interdependence in the first phase of group interaction would be moderated by diversity beliefs, especially for teams, which held negative diversity beliefs. In such teams interpersonal contacts should allow for the development of a superordinate team identity.

According to the categorisation-elaboration model (van Knippenberg et al., 2004), the re-categorisation of the identities towards a superordinate team identity in the partially distributed team should enable further task-related information processing. In a series of experiments, which influenced the development of the categorisation-elaboration model, van Knippenberg (1999) showed that information received from ingroup members was attended and elaborated more thoroughly. It can be assumed, that if the members of the subgroup from the other Universities are categorised as ingroup members, diverse information from the cultural context of the subgroups are integrated in a more elaborate manner. As shown in a study by van Dick et al. (2008), team
identification indirectly influences information elaboration in later phases of the team’s project. In their multilevel analysis, the effect of subjective diversity on the development of a shared team identity at the group level was conditioned by diversity beliefs. Furthermore, the developed identification positively influenced further information elaboration in the teams. In the present study, the indirect effect of team identification on further information elaboration in the second phase of the team project should be replicated. Conditioned on diversity beliefs, task interdependence should influence the development of a shared team identity. The development of a superordinate team identity should then have a positive effect on subsequent information elaboration. Furthermore, it was of interest if the conditioned effect of team identity would have an effect on team innovation.

Hypothesis 2: Contingent on diversity beliefs, task interdependence has a positive effect on the development of a shared team identity. More specifically, the effect will be higher for teams holding pro-similarity beliefs.

Hypothesis 3: Contingent on diversity beliefs, task interdependence has an indirect relationship with group member's information elaboration, mediated by identification with their workgroup. More specifically the effect will be higher for teams holding pro-similarity beliefs.

Hypothesis 4: Contingent on diversity beliefs, task interdependence has an indirect relationship with team innovativeness mediated by identification with their workgroup. More specifically the effect will be higher for teams holding pro-similarity beliefs.
4.3.2 Method

The hypotheses were tested in a quasi-experimental simulation study with 24 projects teams consisting of 144 students coming from differing Universities from Europe and India (IIT). The principle for simulation experiments (c.f. Arrow et al., 2000), which provide externally valid results, guided the operationalisation of the quasi-experimental study within undergraduate courses between the University of Applied Science Northwestern Switzerland (UAS NwS) and the Indian Institute of Technology (IIT) Madras. The course involved a project phase, in which students from both universities were required to collaborate in a partially distributed team setting over the period of 7 weeks.

4.3.2.1 Sample

To investigate the effects of structural task interdependence under conditions of positive goal interdependence a quasi-experimental design using students from globally dispersed Universities was conducted. Altogether five global and virtual courses including 142 students from the IIT Madras and students from the UAS NwS, as well as one course of students from the IIT Madras and the Universidad Politécnica de Madrid, and one course between students of the UAS NwS and the IIT Hyderabad were included. In total 24 teams could be integrated in the overall sample (see Table 6 for an overview). Because of different student attendances of the courses not all the student’s teams could be formed as teams with homogenous contextual dispersion. Therefore, not all the teams contained site specific subgroups with a homogenous group size (Boyer O’Leary & Cummings, 2007).

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1The course later on was extended to the University of Passau, Universidad Politécnica de Madrid and the IIT Hyderabad to gain more data.
Table 6: Sample of the study

<table>
<thead>
<tr>
<th>Team No.</th>
<th>Year</th>
<th>Course</th>
<th>Contextual distribution</th>
<th>Team size</th>
<th>Thatcher's Fau</th>
<th>Treatment group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2010</td>
<td>1st UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.76</td>
<td>Interdependent</td>
</tr>
<tr>
<td>2</td>
<td>2010</td>
<td>1st UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.49</td>
<td>Independent</td>
</tr>
<tr>
<td>3</td>
<td>2010</td>
<td>1st UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.45</td>
<td>Independent</td>
</tr>
<tr>
<td>4</td>
<td>2010</td>
<td>1st UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.43</td>
<td>Interdependent</td>
</tr>
<tr>
<td>5</td>
<td>2010</td>
<td>1st UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.39</td>
<td>Independent</td>
</tr>
<tr>
<td>6</td>
<td>2010</td>
<td>1st UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.34</td>
<td>Interdependent</td>
</tr>
<tr>
<td>7</td>
<td>2011</td>
<td>2nd UAS NwS - IIT M</td>
<td>2 CH - 2 IND</td>
<td>4</td>
<td>.36</td>
<td>Independent</td>
</tr>
<tr>
<td>8</td>
<td>2011</td>
<td>2nd UAS NwS - IIT M</td>
<td>2 CH - 2 IND</td>
<td>4</td>
<td>.30</td>
<td>Interdependent</td>
</tr>
<tr>
<td>9</td>
<td>2011</td>
<td>2nd UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.49</td>
<td>Independent</td>
</tr>
<tr>
<td>10*</td>
<td>2011</td>
<td>2nd UAS NwS - IIT M</td>
<td>2 CH - 3 IND</td>
<td>5</td>
<td>.49</td>
<td>Interdependent</td>
</tr>
<tr>
<td>12</td>
<td>2011</td>
<td>3rd UPM - IIT M</td>
<td>3 E - 3 IND</td>
<td>6</td>
<td>.41</td>
<td>Interdependent</td>
</tr>
<tr>
<td>14</td>
<td>2011</td>
<td>3rd UPM - IIT M</td>
<td>3 E - 3 IND</td>
<td>6</td>
<td>.49</td>
<td>Interdependent</td>
</tr>
<tr>
<td>15*</td>
<td>2011</td>
<td>3rd UPM - IIT M</td>
<td>2 E - 4 IND</td>
<td>6</td>
<td>.72</td>
<td>Independent</td>
</tr>
<tr>
<td>16*</td>
<td>2011</td>
<td>3rd UPM - IIT M</td>
<td>2 E - 3 IND</td>
<td>6</td>
<td>.84</td>
<td>Interdependent</td>
</tr>
<tr>
<td>17</td>
<td>2013</td>
<td>4th UAS NwS - IIT M</td>
<td>3 E - 3 IND</td>
<td>6</td>
<td>.81</td>
<td>Independent</td>
</tr>
<tr>
<td>18</td>
<td>2013</td>
<td>4th UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.68</td>
<td>Interdependent</td>
</tr>
<tr>
<td>19</td>
<td>2013</td>
<td>4th UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.58</td>
<td>Interdependent</td>
</tr>
<tr>
<td>20</td>
<td>2013</td>
<td>4th UAS NwS - IIT M</td>
<td>3 CH - 3 IND</td>
<td>7</td>
<td>.55</td>
<td>Independent</td>
</tr>
<tr>
<td>21</td>
<td>2014</td>
<td>5th UAS NwS - IIT H</td>
<td>3 CH - 3 IND</td>
<td>6</td>
<td>.57</td>
<td>Interdependent</td>
</tr>
<tr>
<td>22*</td>
<td>2014</td>
<td>5th UAS NwS - IIT H</td>
<td>2 CH - 5 IND</td>
<td>7</td>
<td>.44</td>
<td>Independent</td>
</tr>
<tr>
<td>23*</td>
<td>2014</td>
<td>5th UAS NwS - IIT H</td>
<td>3 CH - 5 IND</td>
<td>8</td>
<td>.42</td>
<td>Independent</td>
</tr>
<tr>
<td>24*</td>
<td>2014</td>
<td>5th UAS NwS - IIT H</td>
<td>2 CH - 5 IND</td>
<td>7</td>
<td>.50</td>
<td>Interdependent</td>
</tr>
</tbody>
</table>

University of Applied Science Northwestern Switzerland (UAS NwS) students in Applied Psychology, Indian Institute of Technology (IIT M) students in engineering, software development, biopharmaceutical and HR, Universidad Politécnica de Madrid (UPM) students in Engineering and Management including some exchange students, Indian Institute of Technology Hyderabad (IIT H) students in Engineering and software development
4.3.2.2 Experimental simulation

The claimed principle of contextual realism for studying teams as complex, adaptive systems (Arrow et al., 2005, 2000) was taken into account for the simulation of naturalistic circumstances. The essence of experimental simulation is that the experimenter tries to create conditions similar to a real-world environment, selects participants with some degree of similarity towards the referent real-world population of the system, and provides technology and resources, which enable the groups’ to operate on projects similar to real world conditions. This should allow the study of groups as dynamic systems as the individuals are studied within a context, which provides conditions to produce outcomes and results in a 'systems operation time'. To achieve a high standard of the simulation, it is important to provide activities that have meaningful consequences for involved participants (cf. Arrow et al., 2000).

The simulation experiment was conducted as follows: Students imagined themselves in a company involved in a business context, cross-cutting the national and continental boundaries. The business involved companies operating between Europe and India. For those companies they had the task of either developing concepts for products or shared policies regarding corporate social responsibility issues (CSR), which then had to be sold or implemented. In the experiment at hand the task required the integration of the country specific expertise of the students from both Universities for the development of involved integrative solutions. The task required the identification of differences regarding the context of use of specific products or the different challenges regarding CSR issues, for example in the case of developing a part of a gender policy for a company. The identification of differences should facilitate higher order information processing of comparing different understandings, which should then be used for developing the solutions, integrating perspectives from both cultural backgrounds.

The main task was the development of a concept that was to be implemented in a business setting bridging the countries involved. The task thereby required the integration of differing country specific cultural perspectives as the products or policy programs should address target groups in both countries (see Appendix B for general task descriptions). In the task descriptions of the experimental simulation the focus of integrating the two country specific perspectives, by finding similarities in target groups and contexts of use or implementation, was accentuated to reinforce interdependency on the level of goals. Furthermore, goal interdependence was framed by giving them team based rewards in the form of a competition for the best and most creative students group (cf. De Dreu, 2007).

Task interdependence was manipulated in the first phase of the project by differing process instructions (cf. Wageman, 2001) for the first phase of the team project until the midpoint of team work (see Appendix C for manipulation of task interdependence in process instructions).
Independent teams received the instruction that they were to start with an analysis in country specific groups (IVA1). Only after completing this first country specific analysis they could meet to discuss their results and start with an integrated analysis for similarities between the countries. The interdependent groups, in contrast, received the instruction to start the analysis of similarities from the start of the work in their global and virtual team. The task under the interdependent condition required the teams to work by relying on the different expertise of the team members of their cultural, social and business contexts in their respective countries. The students were instructed to scan both environments and think about possibilities, which could be used as starting point for the development of the integrative concepts or products (IVA2; see Table 7).

Table 7: Quasi-experimental design

<table>
<thead>
<tr>
<th>Groups</th>
<th>t₀</th>
<th>IV</th>
<th>t₁</th>
<th>t₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment teams (9)</td>
<td>screening</td>
<td>IVA1</td>
<td>process &amp; control V</td>
<td>process &amp; DV</td>
</tr>
<tr>
<td></td>
<td>questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non treatment teams (9)</td>
<td>screening</td>
<td>IVA2</td>
<td>process &amp; control V</td>
<td>process &amp; DV</td>
</tr>
<tr>
<td></td>
<td>questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3.2.3 Measures

In the following paragraphs the measures assessed at the different measurement time points will be presented. Furthermore, respective methods for controlling culture specific response styles, and aggregation on the team level will be presented.

Screening questionnaire (t₀)

Before the start of the course a screening questionnaire was sent to all participants in the joint courses of the respective years. The questionnaire was distributed electronically via a digital survey tool. By means of the screening questionnaire general demographic variables such as age, gender, ethnicity, the exact study discipline as well as their amount of intercultural experience and cultural intelligence (Ang et al., 2007) were assessed.

More relevant for the subsequent data analysis was the assessment of diversity beliefs as proposed in the studies by Homan et al. (2007) van Dick et al. (2008). Diversity beliefs can be subdivided into pro-similarity beliefs, reflecting positive attitudes towards homogeneity in work groups and teams, as well as pro-diversity beliefs reflecting positive attitudes towards diversity in work teams. For this study the proposed scale by van Dick et al (2008) was applied. This scale measures both aspects of
diversity beliefs. As mentioned by the authors, the scale may assess different dimensions of diversity beliefs (positive and negative). The scales psychometric reliability was validated in several studies with respective samples (cf. Adesokan et al., 2011; Homan et al., 2008; van Dick et al., 2008). According to non-representative sampling methods and the small sample size, reliability testing of already validated scales was not perceived as necessary (if there is an interest in respective reliability and distribution scores, they are listed in Appendix E). As in the study conducted by van Dick et al. (2008), this scale was used for the subsequent tests of the moderation hypothesis. As the scale clearly assesses beliefs on an individual level, level issues for accounting for effects on the team level had to be resolved. As diversity beliefs are understood as relatively stable, individual characteristics (cf. Homan et al., 2008), they can be seen as an additive compositional model (Chan, 1998) for the group level construct of diversity beliefs. However, it seems important to control for standard deviations of the group level means in the subsequent analysis (Meyer & Schermuly, 2012). Therefore, the team level diversity beliefs values were z-transformed for further analysis.

**Assessment of team process variables (t1)**

The team process variables were assessed at the midpoint of the team project in week three of the collaboration. A questionnaire was distributed electronically via a digital survey tool.

*Behavioural integration.* To check for the manipulation of task interdependence in the first phase of the teams project a measure of behavioural integration or interdependence, as proposed by Li and Hambrick (2005; pp. 799), was assessed (if there is an interest in respective reliability and distribution scores, they are listed in Appendix E). The scale is meant to assess 'the degree to which mutual and collective interaction exists within the group' and was therefore chosen to assess the construct of actual or behavioural interdependence as opposed to structural interdependence (Wageman, 2001). Furthermore, at the midpoint of the students’ project the following process variables of interest were assessed for further analysis of the posited hypothesis.

*Information elaboration.* Information elaboration in the team was assessed with the 7-item scale proposed by van Dick et al. (2008) on a five point-Likert scale ranging from a strong disagreement to a strong agreement to the statements claiming perceived information elaboration in the team. The scale contains 7 items, which were adapted to the context of the study. The following items assessed information elaboration in the partially distributed teams: 'My global and virtual team members exchange a lot of information about the task.'; 'My global and virtual team members often say things about the task that make me think'; 'In my global and virtual team, we discuss the content of our work a lot.'; 'In my global and virtual team, we often talk about our ideas about the task'; 'My global and virtual team members often say things that lead me to learn something new about the task'; 'My
global and virtual team members often say things that lead me to new ideas'; 'I often think deeply about what the team members from the other University say about the task'.

**Team psychological safety climate.** Team psychological safety was assessed with the short scale for assessing the tacit beliefs of the group member's regarding the propensity for risk taking in the teams originally developed by Edmondson (1999). The following 5 items of the scale were assessed: 'If you make a mistake on this team, it is often held against you.'; 'Members of this team are able to bring up problems and tough issues.'; 'People in this team sometimes reject others for being different.'; 'It is difficult to ask other members of this team for help.'; 'My team members value my unique skills and talents.'

**Team identity.** The measure of team identity reflects the perception and identification with the working group as a cohesive system. This scale was adapted from a scale originally developed from the insights of a qualitative-explorative study about team identity in partially distributed teams by Earley and Mosakowski (2000). The scale included the following three adapted items for the purpose of this study: 'The feeling that we are all sharing a common set of beliefs and values is high in our global and virtual team'; 'Our global and virtual team has a strong sense of what is'; 'In our team we acted as a single cohesive team'.

**Assessment of team process and outcome variables (t2)**

The same team process variables were assessed after the midpoint phase of the project with an online questionnaire, administered one day after the final meeting, where the students presented the results of their projects.

**Team innovation.** To assess a rating of the team outcomes independent from the subjective ratings of the involved team members, the outcomes of the team task (developed advertisements of products or developed policy programs) were rated after the student's presentations at the final virtual meeting by independent experts. The outcomes were rated by two professors; one from the UAS NwS and one professor from the IIT Madras. The experts were not informed about the experimental procedure and manipulation of task interdependence conditions, and rated the innovativeness of the group outcomes on a 5-point likert scale ranging from very low to very high. All outcomes of the differing courses were rated by the same two experts. Interrater reliability was calculated with a two-way consistency intra-class correlation coefficient (Shrout & Fleiss, 1979). According to common definitions of innovation (cf. Anderson et al., 2004; Bledow et al., 2009) innovation is differentiated here from creativity, as it involves the creation and implementation of something new for a specific context or system. Thereby the outcomes of innovation can be
products, processes or organisational changes, which are not only stated as ideas (which can be seen as outcomes of a creative process), but have to be implemented in a specific context.

According to the definition of innovation the following criteria were selected for the rating of the innovativeness of the team outcomes by the two experts: creativity of the developed ideas (ICC = .63) as well as an estimation of the efficiency of the proposed solution in the specific context of use (ICC = .63). The different cultural and academic backgrounds of the two selected experts (Switzerland and India, and Management and Applied Psychology) could account for the just acceptable scores of the intra-class correlation measures. The scores of the expert ratings subsequently aggregated to an overall measure of the innovativeness of the proposed solution.

**Control variables**

To assess the probability of the formation of demographic faultlines along the site specific subgroups as a control variable in this study, the most frequently used faultline strength measure proposed by Thatcher, Jehn and Zanutto (2003) was chosen. The measure was chosen because it was important to know about the potentiality of building two site specific groups, by demographic characteristics which could not be controlled in the quasi-experimental setting (age, gender and discipline of study).

According to the simulation-based comparison of faultline measures by Meyer and Glenz (2013b) this measure allows to integrate numeric as well as categorical data, it provides a reliable measure of the probability of forming site specific subgroups - the faultline strength - limited to two possible subgroups. The measure is based on a variance-based cluster analysis of the assessed diversity measures and provides a member-to subgroup-fit for the fixed 2-factor solution. In this study the probability for forming two site-specific subgroups along the defined diversity characteristics should be controlled, so this measure seemed to fit the requirements. Classic demographic characteristics (age, gender and discipline of study) were added to calculate the demographic faultlines in the teams as a control variable (Meyer & Schermuly, 2012). The fautllines were calculated with the ASW cluster package developed for R by Meyer and Glenz (2013a).

To control for the unequal contextual distribution (Boyer O’Leary & Cummings, 2007) regarding the size of the location specific subteams, a further categorical control variable was introduced. The variable simply assessed, if the location specific subgroup size was homogenous (in two or three persons subgroups on each site) or if the subgroup size differed at the involved locations. Preliminary analysis on the individual level showed a significant interaction effect between the central independent variable task interdependence and the contextual dispersion on the team outcome innovation (F(1, 142) = 28.52; p < .001). The direction of the interaction indicated that the expected effects of task interdependence only occurred in teams with homogenous subgroup size at each site (either three or two persons per site). Therefore, statistical inference tests of the experimental
hypothesis team with non-homogenous subgroups at each site were excluded (see team marked with a * in Table 6).

**Control for culture specific response styles**

Preliminary analysis of variance demonstrated that the Indian student group across all courses showed acquiescence response style (Smith, 2004) on the ratings of the process as well as the outcome variables. Such a response style can be interpreted as a culture specific communication style with a higher occurrence in low uncertainty avoidance cultures. National cultures with a higher power distance and masculinity index values (Hofstede, 2001), as the Indian culture, could be shown (T. Johnson, Kulesa, Cho, & Shavitt, 2005) to have a higher average of acquiescence response style. According to Fischer and Milfont (2010) it is important to correct for response biases in applied research, because not correcting for such biases might lead to distorted research findings. First of all, such differences in response styles might be corrected by using inversed scales with positively and negatively rated items. As in this study, not all the scales contained inversed items, this option was excluded. In the case where no correction of response styles through item inversion can be achieved, assessed values can be corrected by using means or standard deviations. According to Fischer and Milfont (2010) there are three major standardisation methods to adjust values in inter- and cross-cultural research:

- Across variables for each individual (within-subject standardisation)
- Across individuals for each variable (within-group standardisation)
- Methods that use both variables and individuals within a sample from people with the same cultural background (within-culture standardisation)

The easiest way to correct for acquiescence bias may be achieved through a within-subject standardisation or ipsatisation (Hicks, 1970, cit. in Fischer & Milfont, 2010). With this procedure, the average across all variables for an individual is subtracted from the raw score of a specific variable. In the case of the students’ ratings of the actual team states, medium to high inter-correlations of scales were expected. In such cases the use of ipsatisation scores for correction of acquiescence response bias is not recommended (Fischer, 2004). Research questions that focus on the relative importance of variables within samples do not match the procedure of ipsatisation to correct for acquiescence response bias, as the scores are relative to the individual mean scores or standard deviations.

If results of individual level relationships are of interest without considering group differences (for example between cultural groups), such as in OLS-based regression models, according to Fischer
within-group-centering should be used to control for group level differences. For the research question regarding possible mediation effects of task interdependence and the moderated effects in the development of team identity in partially distributed teams, OLS-based regressions within group or within culture standardisation methods would be recommended. As the acquiescence bias was not expected to have the same magnitude on every of the assessed construct, a within group standardisation was chosen. This method allows for the control of differences between the two major cultural groups (Western European, Indian). To control for such between-culture group differences z-transformations within each culture group on the level of scales was conducted to eliminate any mean difference across the samples (Fischer, 2004).

**Team level aggregation for the test of main effects on the team level**

As the team experimental treatment and the outcome variable were both on the group level it was decided to check for the main effects and the mediation hypothesis on the group level, with the expectation of only marginally significant results. The interrater agreement scores for the process scales on the team level were calculated under the assumption of a null distribution of the responses on the assessed scales (see Appendix E). Scores are calculated by comparing the actual to an expected variance. Most frequently, the expected variance reflects the variance of ratings when there is a complete lack of agreement between the judges. Such a complete lack of agreement implies a theoretical null distribution of the responses under the assumptions of normal distribution. Even though -scores might be skewed when the assumption of normal distribution is violated, in most cases the -scores, which assume normal distribution, seem to be quite robust (James, Demaree, & Wolf, 1993).

For evaluating actual -scores, standards were set for co-located teams working together in a shared work context, such as an office space, the agreement scores for distributed or virtual teams can be expected to be lower because people are working in different work contexts. Especially for partially distributed teams where two subgroups are involved, the potential of not sharing the same understanding of the actual states and processes of the team probably increases (Polzer et al., 2006). For the team measures of this study at the midpoint (t1) the calculated -scores resulted for nearly all the teams in acceptable standards as proposed by 0.6 proposed by James et al. (1993). Regarding the process variable assessed at the midpoint only one team had lower scores for the scale, which assessed information elaboration, as well as the scale, which assessed a psychologically safe communication climate (see detailed table in Appendix F). As it seemed to be an exception, and the sample of teams was already quite small, the team was integrated in the aggregated data set for statistical analysis on the team level.
4.3.2.4 Analysis

In the following statistical inference methods for estimation of indirect and conditioned effects will be presented.

Method for estimating statistical inferences of indirect effects on the team level

To test for the mediation hypothesis on the team level, several options to estimate statistical inference of the effects are available. As formerly proposed by Baron and Kenny (1986) a causal step analysis can be chosen. The causal step’s strategy operates with a series of OLS-based regression analyses, in which first a main effect of the independent variable has to be tested. Then the main effect of the independent variable on the mediating variable is tested. In the last step the independent as well as the mediator variable are regressed on the independent variable. The problem with such a procedure is that it does not directly make statistical estimations of the magnitude of the main focus of the researcher’s interest, the indirect path effect. Furthermore, the causal steps strategy depends on the rejection of three consecutive regression analyses and therefore the propensity for making statistically false estimations increases in the same time as the power of the test decreases (Hayes & Scharkow, 2013). To claim for a significant indirect effect it seems more reasonable to test it only with a single inference test. This also prevents further flaw of the causal step’s strategy: the practice of stopping further statistical analyses when no main effect between the independent and the dependent variable could be found. If one assumes several mediation effects, a possible main effect thereby might result in a value around zero because of the differing magnitudes of the involved indirect effects. Therefore, the practice of stopping further analyses after detecting a non-significant, might lead to non-detected indirect effects (Hayes, 2013).

Statistical inference for direct estimation of indirect effects can be made under the assumptions of the normal test theory in the product of coefficient approach to inference (Preacher & Hayes, 2004). For example, in Sobel tests (Sobel, 1987) the effect of the indirect path ab is calculated as a sample specific estimate of the correlation weights of a and b on the independent variable. The standard error of the path ab is estimated in various forms of the combinations of the standard errors of a and b. Such tests allow for a direct statistical inference of the indirect path effects and therefore are able to overcome some of the mentioned problems of the causal steps strategy (Hayes, 2013).

However, some of the problems still remain, especially in the case of smaller samples, as in the study at hand. The first problem is the heavy reliance of those statistical procedures on the assumption of normal distribution of path coefficients. As results from empirical and simulation studies show (Bollen & Stine, 1990; Craig, 1936; Stone & Sobel, 1990, cit. in Hayes, 2013) such an assumption is expected to be less valid in smaller samples, although such studies are standard in social science and psychological studies. For the team sample which had to be reduced to only 18 teams this flaw might
have been aggravated. Furthermore, statistical inference tests of the mediation of a main effect via one or several process variables - so-called normal theory tests (Preacher & Hayes, 2004) - are low in power and generate less accurate estimates of confidence intervals (Hayes, 2013). Therefore, in this study the approach proposed by Preacher and Hayes (2008) was chosen, which estimates statistical inference of indirect effects using the bootstrapping resampling method. The bootstrapping method takes the assessed sample as a mini representation of the originally sampled population. Therefore an approximate sampling reference should be achieved for adequate bootstrapping results. In the bootstrapping approach mini samples are resampled k-times so that a specification of the effects in the population can be made. According to Hayes (2013) a number of bootstrapped resamples of approximately 10'000 lead to relatively stable results. In the case of the mediation analysis bootstrapping is used to make estimations of the distribution of the indirect effect ab. This distribution is then used to calculate confidence intervals (CIs) for the indirect effect in the estimated model.

Practically there are six steps involved in the bootstrapping process for estimating indirect effects. First, a random sample from the original sample is taken as base bootstrap sample. The serial indirect effect as hypothesised is estimated from the following regression equations:

\[ M_1 = i_1 + a_1X + e_{M_1} \]  
\[ M_2 = i_2 + a_2X + d_{21}M_1 + e_{M_2} \]  
\[ Y = i_Y + c'X + b_1M_1 + b_2M_2 + e_Y \]

After the steps of bootstrap resampling and estimating, the indirect is repeated k-times. In this study a bootstrap resampling repetition of 10'000 times was estimated as sufficient (cf. Hayes, 2013). This confidence interval might slightly differ according to the bootstrap samples in the study, whereas normally the estimates are accurate when repetitions of the sample from over 5'000 are considered. Such bias corrected CIs are adjusted regarding the skeweness of the distribution of k bootstrap estimates. They are calculated by computing Z-scores that cut off the lower and upper 100% of the standard normal distribution. The scores can then be used to estimate the percentile values of the upper and lower bounds of the CI. The calculated CIs can be used to define the statistical inference of positive and negative indirect effects. In both ways the CIs should not straddle zero for claiming rather a negative or a positive indirect effect; when straddling zero the percentile bootstrap confidence interval cannot be defined as clearly being positive or negative. For this study confidence intervals of 95% were chosen.

Regardless of the number of integrated mediators in the model the direct effect in an indirect model can always be estimated from the regression of X on Y from the following equation:
\[ Y = i_3 + cX + e_y \] (4)

The direct effect \( c' \) thereby can be interpreted as one of the difference in \( Y \) caused by the move of one unit on the independent variable \( X \). The indirect effects are estimated by multiplying the regression weights of each step in indirect model, and can be interpreted as the difference in one unit in \( Y \) caused by the causal effects of \( X \) via the proposed mediators. In a two mediators serial model, as proposed here, the total effect \( c \) can be calculated from the direct \( c' \) and indirect effects according to the following equation (Hayes, 2013):

\[ c = c' + a_1 b_1 + a_2 b_2 + a_3 d_1 b_2 \] (5)

**Method for estimating statistical inferences of conditional effects**

To test the conditional effect of the perception of diversity on the development of team identification, moderation analysis using multiple OLS based regression analysis was conducted (cf. Aiken & West, 1991; Hayes & Matthes, 2009; Hayes, 2013). Moderated regression analysis rests under the assumption that an effect of \( X \) on \( Y \) differs regarding the values of third variable. Normal multiple regression analysis calculates an effect of a third variable, which is unconditional on the effect of \( X \). Therefore, for estimating conditional effects the equation, multiple regression has to be changed to integrate a conditional effect of \( M \) on \( X \), like in the following equation:

\[ Y = i_1 + (b_1 + b_3 M)X + b_2 M + e_y \] (6)

Whereby \( b_1 \) is the intercept and \( b_3 \) is the regression slope of an effect of \( X \) on \( Y \). This equation is normally transferred into the well known product of the interaction terms equation:

\[ Y = i_1 + b_1 X + b_2 M + b_3 XM + e_y \] (7)

\[ \hat{Y} = i_1 + b_1 X + b_2 M + b_3 XM \] (8)

This model allows for the estimation of an effect where \( X \) on \( Y \) dependent on \( M \), a so called conditional model. The equation (6) estimates how much a unit change \( X \) changes \( Y \) in a given value of \( M \). The regression slope \( b_3 \) signifies the impact of one move on \( M \) to the effect of \( X \) on \( Y \), thereby indicating the conditional effect. Care has to be taken in interpreting the regressions slopes \( b_1 \) as well as \( b_2 \) as they do not represent the partial effects or main effect of the predictor variables \( X \) and \( M \), but rather are conditional. The regression weight \( b_1 \) quantifies the effect of \( X \) on \( Y \) when \( M \) is held
constant, whereas $b_2$ quantifies the effect of M on Y when X is held constant. A confusion of regression weights, as used in multiple regression in conditional models, might lead to misinterpretations of the regression weights, seen as partial or main effects (cf. Hayes, 2013).

The conditional effect of X on Y can be visualised to understand the magnitude, but as always in statistics, one might like to probe for the statistical inference. Several methods for statistical inference testing of interaction effects are available in conditional models. The most commonly used represents the Pick-a-Point approach used with mean centering. In this approach values of M for testing the interaction are selected, most of the time values +/- SD deviations are selected for estimating the standard error of the conditional effect of X (Aiken & West, 1991). This method has one major flaw, namely that the values of M are chosen arbitrarily without theoretical considerations (Hayes, 2013). For this study a method was chosen, which does not incline the choice of a certain value of M for probing the conditional effect, the Johnson-Neyman (J-N) technique. With this method critical t values are calculated which indicate ratio of the conditional effect to its standard error.

$$t_{crit} = \frac{b_1 + b_3M}{\sqrt{se_{b_1}^2 + (2M)COV_{b_1b_2} + M^2se_{b_3}^2}} \tag{9}$$

This equation estimates the values of M that demarcate the continuum, in which the conditional effect reaches significance. The estimates in this study were all calculated with the process macro developed by Hayes (2013).

For statistical inference of the conditional indirect effects as the following regression equations were relevant for estimation:

$$M = i_1 + a_1X + a_2W + a_3XW + e_y \tag{10}$$
$$Y = i_2 + c'_1X + c'_2W + c'_3XW + bM + e_y \tag{11}$$

W signified the moderating variable diversity beliefs and M the process variable of the respective hypothesis.
4.3.3 Results

To start with the presentation of the results, the manipulation of the treatment variable will be checked. Furthermore, descriptive correlations on the team level will be presented to get an overview of the relationships between the assessed variables. Finally, subsequent statistical inference tests of the treatment groups will be shown. The results of the indirect and conditional effects, regarding the relationships between task interdependence and information elaboration, a psychologically safe team climate as well team identification in the partially distributed teams will presented below.

4.3.3.1 Descriptives and controls

In the following the check of the treatment variable task interdependence and the correlation matrix will be presented (further descriptive of the team level variables can be found in Appendix F)

Manipulation check

Behavioural integration was assessed as a check of the experimental treatment of task interdependence in the first phase of the team project. The ANCOVA was marginally significant ($F_{1,15} = 1.112; p = .069$). Interdependent teams did perceive a higher integration in the first phase of the project ($M = .145$) compared to independent teams ($M = -.233$). According to the relatively small sample size the treatment of task interdependence was estimated to be effective.

Correlation matrix

Table 8 shows the within-group standardised correlation matrix for the relevant process as well as team outcome variables. Team process variables are moderately to highly correlated, indicating positive relationships between information elaboration and team identification, as well as team psychological safety.

Regarding the relation between team process variables and team outcomes, information elaboration is moderately correlated with the expert ratings of the innovativeness of team outcomes. The team climate variable, psychological safety, is moderately related to outputs of the expert rating of team innovativeness.
Table 8: Correlation of process and outcome variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>1.)</th>
<th>2.)</th>
<th>3.)</th>
<th>4.)</th>
<th>5.)</th>
<th>6.)</th>
<th>7.)</th>
<th>8.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.) Faultline strength</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.) Diversity beliefs</td>
<td>-.139</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.) Information elaboration t1</td>
<td>-.158</td>
<td>-.106</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.) Information elaboration t2</td>
<td>-.135</td>
<td>-.181</td>
<td>.738**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.) team identification t1</td>
<td>-.251</td>
<td>.149</td>
<td>.539*</td>
<td>.549*</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.) team identification t2</td>
<td>-.026</td>
<td>-.230</td>
<td>.414</td>
<td>.614**</td>
<td>.265</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.) Safe psychological climate t1</td>
<td>-.379</td>
<td>-.354</td>
<td>.721**</td>
<td>.598**</td>
<td>.450</td>
<td>.556*</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>8.) Safe psychological climate t2</td>
<td>-.040</td>
<td>-.430</td>
<td>.261</td>
<td>.496*</td>
<td>.252</td>
<td>.806**</td>
<td>.608**</td>
<td>–</td>
</tr>
<tr>
<td>9.) Innovation expert rating</td>
<td>.060</td>
<td>-.442</td>
<td>.472*</td>
<td>.198</td>
<td>.006</td>
<td>.558*</td>
<td>.743**</td>
<td>.623*</td>
</tr>
</tbody>
</table>

Remarks: n= 18; * p < .05, ** p < .01, spearman-brown correlations

4.3.3.2 Inferential test of hypothesis

In the following paragraphs the estimates of the inferential test of the indirect and conditional hypothesis will be presented. Beforehand, the assumptions for the inferential statistical estimates are checked (see Appendix D for further elaborations on the requirements for statistical inference in the estimated models)

Testing of hypothesised indirect effects of task interdependence

For the hypothesized indirect effects, the assumption of homoscedacity was checked by visual scatterplots of the residuals in functions of predicted values of Ŷ. The scatterplot did not indicate any linear relationship between the residuals and the predicted values. Furthermore, for additional checks of linearity of the scatterplots of the mediators, the dependent variables were plotted. The scatterplots indicated no severe deviation from the linearity assumption. As the correlation matrix shows, there was a rather high correlation between the two assumed indirect variables and the variance inflation factor (VIF) of the multiple regression model, integrating both mediating variables with a result of 2.1 of VIF (indicating moderate variance inflation). In the case of moderate multicollinearity, single mediation models are prone to be confounded by omitting the effects of the other mediator. According to the moderate multi-collinearity between the two process variables it seemed more reasonable to integrate both process variables in a serial model, even though a certain decrease in power had to be accepted (cf. Hayes, 2013).
Table 9: Regression coefficients, standard errors, and model summary for the serial indirect model

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Consequent</th>
<th>( M_1 (\text{InfoElab} t_1) )</th>
<th>( M_2 (\text{PsychSafety} t_1) )</th>
<th>( Y (\text{TeamInno} t_2) )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coeff. SE p</td>
<td>Coeff. SE p</td>
<td>Coeff. SE p</td>
</tr>
<tr>
<td>Control ( T' ) Fau</td>
<td>( a_1 ) ( .619 ) ( .252 ) ( .027^* )</td>
<td>( a_2 ) ( .339 ) ( .190 ) ( .097 )</td>
<td>( c' ) ( .343 ) ( .454 ) ( .464 )</td>
<td></td>
</tr>
<tr>
<td>( X (\text{InterD}) )</td>
<td>( d_{12} ) ( .423 ) ( .164 ) ( .022^* )</td>
<td>( b_1 ) ( -.215 ) ( .430 ) ( .626 )</td>
<td>( b_2 ) ( 1.386 ) ( .576 ) ( .032^* )</td>
<td></td>
</tr>
<tr>
<td>( M_3 (\text{InfoElab}) )</td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>( M_2 (\text{PsychSafety}) )</td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>Constant</td>
<td>( i_M ) ( -.904 ) ( .394 ) ( .036 )</td>
<td>( i_{M2} ) ( -.545 ) ( .292 ) ( .083 )</td>
<td>( i_Y ) ( -.136 ) ( .703 ) ( .849 )</td>
<td></td>
</tr>
</tbody>
</table>

* \( p < .05; ** p < .01 \)

\( R^2 = .591 \) \( F (2, 15) = 4.023 \) \( p = .040 \)

\( R^2 = .710 \) \( F (3, 14) = 11.450 \) \( p < .001 \)

\( R^2 = .745 \) \( F (4, 13) = 4.061 \) \( p = .024 \)

The results of the overview of the single regressions of the causal steps analysis are displayed in Table 9. The results show that teams with interdependent tasks from the beginning of their projects were able to elaborate task relevant information more thoroughly (\( a_1 = .619 \)). Furthermore it can be assumed that a deep and thorough information elaboration is enabling the development of a safe communication climate in the teams (\( d_{12} = .423 \)). This communication climate is then directly related to the innovativeness of the team outcomes at the end of the project (\( b_2 = 1.386 \)).

The bias-corrected bootstrap intervals for the involved indirect effects (see Figure 6) did not straddle zero for effects \( a_2 b_2 \) (4.70, lower limit CI = .037; upper limit CI = 1.52) and \( a_1 d_{21} b_2 \) (.363 lower limit CI = .057; upper limit CI = 1.30). Thus indicating that with a probability of 95%, the indirect effects are positive for the proposed paths \( a_2 b_2 \) and \( a_1 d_{21} b_2 \). The contrasts of the bias-corrected bootstrap intervals of the indirect effects \( a_2 b_2 \) and \( a_1 d_{21} b_2 \) did straddle zero, thereby indicating that there was no significant difference between the two indirect effects.
Furthermore, the indirect effect $a_1b_1$ did not straddle zero, but when the factor information elaboration was included in the model, the paths $a_2$ did not reach significance anymore. The total effect of task interdependence on team innovation ($c = 1.04; p = .020$) was completely mediated by the serial indirect effect of information elaboration and the emergence of a psychologically safe team climate $a_1d_{21}b_2$ ($c' = .343; p = .464$).

**Diversity beliefs as moderating factors in the development of shared team identification**

The conditional effects regarding the influence of the motivational factor diversity beliefs were tested on the development of a shared team identity. Before conducting the conditional inference tests, the assumptions for OLS-based regressions were checked. For the hypothesised conditional effect. The assumption of homoscedacity was checked by visual scatterplots of the residuals in functions of predicted values of $\hat{Y}$. The scatterplot did not indicate any linear relationship between the residuals and the predicted values. Furthermore, for additional checks of linearity scatterplots of the product of the moderator and the predictor variable on the dependent variables were plotted. The scatterplots indicated no deviation from the linearity assumption.
The regression coefficients in Table 10 show a non-significant conditional effect of the focal predictor task interdependence (TI) on the process variable team identification (TeamID). In addition, the overall conditional regression model, including the moderator diversity beliefs (DB), is non-significant. The adjusted $R^2$ was moderate in the 10'000 boot-strapped sample analysis. Even though the overall conditional model is non-significant, the significant interaction between the moderator variable diversity beliefs and the predictor variable diversity beliefs could be assumed to be an indication for a conditional effect of task interdependence on the development of a superordinate team identity in the partially distributed students’ teams.
As can be seen in Figure 7 task interdependence seems to have a more positive effect when team members tend to have pro-similarity beliefs. To probe for this interaction effect, the Johnson-Neyman technique was applied. The conditional effect of diversity beliefs on team identity was significant, according to the Johnson-Neyman critical t-value ($t_{crit}$) for z-transformed values in diversity beliefs below -.480. The region of significance of the effect of X on the mediator team identification is thereby defined by one value $t_{crit}$ in this equation. For the the teams below, the critical t-value task interdependence has a positive effect on the development of team identification in partially distributed settings: the confidence interval for values below $t_{crit}$ are all above zero. For the teams, with values above the second critical t-value $t_{crit} = .827$ identified using the Johnson-Neyman approximation, the effect is reversed. However, this effect has been taken with care as the sample size and the respective teams within this range are quite small, and effects could have been overestimated through the boot-strapping procedure.
Figure 8: Conditional indirect effect of task interdependence on information elaboration

The hypothesised conditional indirect effect of task interdependence via team identification was actually occurring for teams with pro-similarity beliefs, with values below the mentioned $\epsilon_{crit}$. The first model of the conditional indirect effect of task interdependence, via team identification on the elaboration of task-related information for teams with values of one standard deviation below, was significant ($F= 7.29; p = .003$; see Table 10). With regard to the estimated coefficients of the conditioned indirect model, the indirect variable team identification is positively related to information elaboration in teams (lower limit CI = .204 upper limit CI = .862). The bootstrapped confidence intervals for the conditional direct effect of task interdependence ($c'_{1}$) also straddled zero (lower limit CI = .165; upper limit CI = .958). Therefore, besides a small conditioned indirect effect, a conditioned effect of task interdependence could be identified (see Figure 8). The conditional indirect effect of task interdependence, via team identification on team innovativeness (see $Y_{2}(TeamInno)$ in Table 10), did not reach significance. On the other hand, the direct conditional positive effect of task interdependence did reach significance ($t= 2.52; p = .024$) in this model.
4.3.4 Discussion
This study sought the effects of structural task interdependence on both task-related and social
categorisation processes, which enable team innovation in partially distributed settings. In the
present study it was shown that task interdependence in the early episodes of a teams' life positively
effect team innovation. Thus, this study extends findings of previous studies by showing positive
effects of structural forms of interdependence on team innovation in geographically distributed
computer mediated team settings (Hertel et al., 2004). Intercultural research studies assume (Chen
et al., 2005; Tjosvold & Su, 2007), that by structuring cooperative interdependent goals, a work
environment can be created, in which conflicts of interest and goals can be attenuated. In vein with a
recent study in the field of faultline teams by Rico et al. (2012), this study provides evidence that goal
interdependence in partially distributed settings might not be enough for achieving team outcomes
in more complex tasks. Rather, the combination of cooperative goal and reward interdependence
with a higher degree of task interdependence, especially in early team episodes, triggers necessary
team processes for achieving innovation.
As this study shows, under conditions of cooperative goal interdependence, increasing task
interdependences in early team episodes lead to a higher amount of information elaboration.
Therefore, task interdependences might be directly related to task specific interaction behaviours.
On the level of task-related processes, it was shown that task interdependence in an early phase of
requirements' definition has a positive effect on task-related information elaboration. The
manipulation of cross-cutting task roles (cf. Bettencourt et al., 2007; Marcus-Newhall et al., 1993)
influences different status indications for group interaction and has the ability to change established
influence patterns between the activated subgroups in globally distributed teams. Structural task
interdependence might be the actual trigger for creativity and innovation, as the competence cues
from subgroups are integrated in a differing manner (cf. Driskell, Olmstead, & Salas, 1993). Thus, the
structural characteristics influence the patterns of risk taking and learning behaviours such as the
elaboration of task-related differences (cf. van Knippenberg et al., 2004).
Furthermore, it could be shown that information elaboration in the teams enables the emergence of
a psychologically safe team climate (Edmondson, 1999), which mediates the effect of task
interdependence on team innovation. In partially distributed, global teams, the emergence of a
psychologically safe communication climate not only enables, but also results from early team
learning behaviours, such as taking the risk for explicating culturally different perspectives on a topic
at hand.
On the level of a more affective and evaluative reception of the team interaction processes, the
results regarding the development of a team identity are of interest. The manipulation of structural
task interdependence did not influence the perception of diversity characteristics as well as the
identification with the partially distributed teams. It seems that for the development of a more inclusive identification with the partially distributed team, the structuring of task interdependences, which cross-cut task role assignments at both sites (Bettencourt et al., 2007; Marcus-Newhall et al., 1993), are not conducive. Furthermore, under conditions of cooperative goal interdependence, behavioural interdependences in the process do not directly influence the subjective perception of diversity characteristics. In line with studies under the common ingroup paradigm (Gaertner & Dovidio, 2000; Gaertner et al., 1999), it is not necessary to define task roles which cross-cut the subgroup boundaries to enable the development of a more inclusive team identity. In this experiment, the preliminary interaction, in combination with the definition of cooperative goal interdependences, were sufficient to induce rather high means of identification with the partially distributed teams (see Appendix F for mean values of team identification at time point one). As goal interdependence and the interaction conditions were not manipulated in the experimental procedure, the effects of goal interdependence and the inaugural interaction for purposes of coordination could not be disentangled.

Even though the overall OLS regression model for the conditioned effect of diversity beliefs on team identification in the first phase of the project was not statistically significant, the significant interaction between diversity beliefs and task interdependence in the model can be seen as an indication for a conditional effect. Therefore, it could be assumed that in teams where people hold negative diversity beliefs, the exposition to an interdependent tasks enables the development of superordinate team identity (J. C. Turner et al., 1987). The results regarding the conditional effects of task interdependence on the development of more inclusive team identification indicate that negative beliefs are mitigated by the experience in task settings, which promote the exchange of diverse perspectives on a topic. These preliminary results correspond with the results of a study by Adesokan et al. (2011), which show similar effects of intergroup contact on the individual level for persons with pro-similarity beliefs. Therefore, negative beliefs about the impact of diversity on work group functioning are mitigated by contacts that are perceived to be valuable for personal goal achievement. The perceived importance and relevance of contact roles for personal goal achievement on prejudice reduction could already be shown in earlier studies by van Dick et al. (2004).

In teams where negative diversity beliefs are held, the structuring of task work environments, where the achievement of team goals are linked to interdependent intergroup contacts, foster the development of a shared team identity. It can be assumed, that in the interdependent task setting of this simulation study, the students had to integrate different country specific perspectives from the start of their projects. The recognition and exchange of cultural differences, thereby, became instrumental for achieving the set task goals of integrating differing views in a product or policy.
Hertel et al. (2004) showed that perceived instrumentality of contacts across national boundaries, which implicate a certain amount of coordination costs, improves team outcomes, especially in early phases of a virtual team's life. Such an early exchange of culturally differing topics would involve processes of de-categorisation by recognising personal differences in the outgroup. Such a process enables a better understanding of differences within the respective contexts. Furthermore, according to the categorisation-elaboration model (cf. van Knippenberg et al., 2004). If team members perceive cultural differences to be a valuable contribution to their goal achievements, negative effects of diversity faultlines can be mitigated. Therefore it is assumed here, that in interdependent teams, in which diversity characteristics were framed to be instrumental for the common goal achievement, articulated differences were accepted and perceived as an important contribution. In the independent task teams, the perception of differences is assumed to be related to a higher degree of intergroup thread. Country specific subgroups were able to further develop towards a group-to-group constellation, increasing a conflict-laden perception of respective differences. In line with the studies by Hentschel et al. (2013), it is assumed here, that it is not the mere quantitative perception of differences, which effects the development of a superordinate team identity, but rather the qualitative valuation of the differences for the task at hand.

The re-categorisation (Gaertner & Dovidio, 2000) towards a superordinate team identity is able to explain the conditional indirect relationship between team identification and information elaboration in the second phase of a teams project. For teams with members holding pro-similarity beliefs (van Knippenberg et al., 2007), the development of a superordinate team identity facilitates more elaborate information processing in later project phases. Therefore, establishing a common team identity enables further task-related information processing in subsequent episodes of a team's life for teams holding pro-similarity beliefs. This can be explained by the fact that, through re-categorisation, a more inclusive category on the level of the partially distributed team is created (Gaertner & Dovidio, 2000; J. C. Turner et al., 1987). Consequently, the members from the subgroup of the other University are then perceived as ingroup members. As was shown in earlier studies by van Knippenberg (1999), messages from ingroup members have a greater likelihood to be more deeply processed. Especially for teams with members holding pro-similarity beliefs, the development of a higher order category considerably increases the quality of information processing. Thus, this study supports the originally claimed propositions in the categorisation-elaboration model, that respective ingroup categorisations influence information elaboration (cf. van Knippenberg et al., 2004). The study still lacks consistent findings in regard to the process of the development of a superordinate team identity.

Regarding innovativeness of team outcomes, however, at least for this experimental setting, team identity and its influence on subsequent information processing was not shown to be the relevant
predictor. In the indirect conditional model, the effects of team identity on team innovation did not reach statistical significance, whereas the direct effects of task interdependence in the model did. Therefore, the indirect effect of task interdependence mediated by information elaboration (van Knippenberg et al., 2007) and the establishment of a psychologically safe team climate (Edmondson, 1999), can be taken as the main predictors of team innovation. This aligns with other studies, which investigated the mitigating effects of a psychologically safe communication climate in distributed teams (Bresman & Zellmer-Bruhn, 2013; Gibson & Gibbs, 2006), and extends the findings toward a better understanding of the process of enabling the development of such a climate in partially distributed global teams. The present results of the study indicate that for enabling innovation in a partially distributed setting for short term task force teams, task interdependence and the management of subsequent processes of information elaboration are essential in a very early phase of a team’s life.

A methodological limitation of the study that needs to be discussed was the hypothetical emergence of an inclusive and task-related team climate. The task-related information elaboration process, as well as the psychologically safe team climate were both measured at the midpoint of the teams project. Therefore, the causal path from information elaboration to the emergence of the team climate (see Figure 6) cannot be explained by study design. The team climate, furthermore, was directly and positively influenced by the manipulation of task interdependence, similar to the effect on information elaboration. As mentioned before, both constructs directly tackle learning processes and, when looking at the operationalisation of both scales to assess these concepts, one might be surprised by the similarities between certain items. However, a clear distinction of the two concepts can be made: Information elaboration addresses merely task-related information processing; whereas the scale of psychological safety in a more encompassing manner assesses socio-emotional processes related to information elaboration activities, as well as helping behaviours, acceptance of errors, etc. One challenge that still persists and needs further refinement in future research is the divergent validity of the operationalisation of team processes and climates. One possible solution could be that a psychologically safe team climate integrates the valuation of structural characteristics, as well as of processes of social categorisation and of task-related processes in the beliefs and attitudes, which structure further interactions (see James & Jones, 1974; James et al., 2008; Schneider et al., 2012 for similar concepts of psychological climates).

A second noteworthy limitation is that the construct psychological safety was assessed in terms of behaviourally relevant group norms, conceptualised originally by Edmondson (1999) as a referent shift model of aggregation (Chan, 1998). Therefore, actual group norms were assessed according to expectations or tacit beliefs regarding behaviours of other group members or referents. This operationalisation is at odds with the proposed direct consensus aggregation model of psychological
climates, as proposed by James et al. (2008). Thereby the climate variable was assessed less as a subjective valuation of the work environment but more in the sense of shared tacit beliefs that might have developed through subjective perceptions of the structures, as well as team's interaction processes. Thus, team level climates would emerge from the subjective valuation of team structures and interaction processes, rather than from the subjective valuation of an abstract work environment. A study of different types of aggregation models by Klein, Conn, Smith and Sorra (2001) showed, that for more descriptive and behavioural measures, the referent models of aggregation seem to generate higher levels of within-group agreement. This result supports an assessment of team level climate variables such as team psychological safety (Edmondson, 1999) via referent shift tacit beliefs.

Due to the small sample size, the results, especially those regarding the conditional indirect model, have to be regarded as preliminary, requiring more detailed research in future studies. To cope with the small sample size, the bias-corrected bootstrapping method as proposed by Hayes (2013) was chosen. Other promising methods, for example structural equation modelling, had to be omitted, because of the sample size requirements. Such methods could have singled out deleterious effects of random measurement errors by latent variable modelling. Furthermore, they could have made it easier to calculate more complicated path models and compare them to their respective model fits. However, as a result of the limited sample size, the choice was made for the bias corrected bootstrapping estimates, as proposed by Hayes (2013). The bias corrected boot-strapping method used in this study has been evaluated as being valid in a comparison of indirect estimates used in studies published in Psychological Science (Hayes & Scharkow, 2013), and therefore was selected for this study. The strength in power has the possible risk of false positive evaluations. For bias corrected bootstrapping estimated effects there is a higher propensity for type one errors. Therefore, results generated with the bias-corrected bootstrapping method have to always be evaluated critically, in the sense of an approximation of possible effects in estimated samples. The different courses in which the study was conducted and the different Universities involved allowed for a broader and more representative sampling of partially distributed teams, which should attenuate possible sampling effects and allow to some degree for generalisation of the results (cf. Shadish, Cook, & Campbell, 2002).
5 General Discussion

In the following paragraphs the results of both studies will be compared following the methodological approach of an explorative, heuristic research strategy (Kleining & Witt, 2001). Convergent results between the field and simulation study, in terms of structural task interdependence as well as to the innovation critical, early transitive team learning episodes will be presented. Also, the differences between the research strategies and the complementarity of the findings of the qualitative, explorative study and the quantitative study as well as methodological limitations will be discussed critically. As a conclusion of the results of the explorative case study, empirically grounded theoretical arguments towards an episodic categorisation-information processing model will be developed. The theoretical framework opens up opportunities for further empirical research and testing of the developed hypothetical relationships in respective team performance episodes (Marks et al., 2001), as well as for a socio-technical design (cf. Anker & Schulze, 2006) of partially distributed global teams.

5.1 The critical relevance of structural task interdependence - Convergent findings of the field and simulation study

Both studies provide strong evidence for the success critical influence of structural task interdependence on innovative team outputs in partially distributed global teams. The field study provides in-depth insights into the differential effects of the discerned characteristics of structural task interdependence on the development of interdependence dynamics throughout innovation projects in real life global teams. In the field study similar characteristics of structural task interdependences could be discerned as already identified by Wageman (2001). Principles of task allocation such as the temporal structuring of task interdependences or sequential or parallel structuring were critical for enabling more complex interdependence rhythms. Those principles were closely related to the perception of distribution and function of expertise on the individual level, as well as centralisation of project structures on an organisational level. In the simulation study the most critical aspects of temporal and process related structuring of task interdependences for enabling innovative team outputs in success critical team performance episodes (Marks et al., 2001) of transitive team learning could be tested.

The main findings which could be supported by both studies can be seen in:

1. The success critical influence of structural task interdependence (Wageman, 2001) on reflexive elaboration of task relevant information (Engeström, 1992; van Knippenberg et al., 2004), and
2. The emergence of a psychologically safe team climate (Edmondson, 1999) from the perception of structurally interdependent tasks, processes of reflexive goal and task elaboration (Engeström, 1992; van Knippenberg et al., 2004), which allow for innovative outputs in global teams

In both studies, it could be shown that an early cross-site structuring of highly intense task interdependences, was required to reflexively elaborate different understandings of the innovative aim (cf. Engeström, 1992). It was more effective to simultaneously structure tasks in a cross-site setting than involving teams at each site separately. The simulation study provides evidence that when teams are involved in site specific subgroup tasks, cross-site team learning processes will be more difficult to establish. Independent phases in the early stage of requirements analysis led to lower levels of team innovation. When the teams were interdependently developing requirements across sites, innovativeness could be increased even in the short time span of only seven weeks. In the field study, such goal and task-related information elaboration was supported by the collocation of engineers to the respective sites. The relevance of contextually embedded knowledge and information (cf. Cramton, 2002) required practices of shared attention towards the innovation object and reflexive communication to develop an early goal understanding (cf. Engeström, 1992). Such communications were enabled through leaders who valued differences in understanding, but also forced the team members to achieve a common ground regarding the innovation objectives. In the simulation study, it could be shown that through the increase in required task interdependences in early project phases such a shared attention towards the innovation objectives can also be achieved in completely distributed team settings without possibilities of f2f contacts. Furthermore, both studies provide evidence for the critical influence of structural task interdependence on the emergence of a psychologically safe team climate (Edmondson, 1999). Such a climate enables involved team members to bring in further innovative ideas, and results in innovative team outputs. According to the exploratory results of both studies, it is not team identity that is supporting learning behaviours in early transitive team learning episodes, but rather a climate that supports the valuation of different opinions and ideas. According to Edmondson (1999) 'team psychological safety is not the same as group cohesiveness'. Group cohesiveness or identity might lead to negative effects, such as groupthink (Janis, 1982). Alternatively, team psychological safety is defined as a shared propensity or disposition of a team to actually engage in risk taking and learning behaviours (Edmondson, 1999). In psychologically safe teams shared beliefs emerge, which enable inquiry behaviours, such as questioning, learning from different perspectives and errors. In line with a study by Gibson and Gibbs (2006), a psychological team climate was able to mitigate negative effects of cultural diversity and geographical distribution on team innovation.
Both studies of this contribution, contrary to the field studies by Edmondson (1999), studied task force or project teams, which were established adhoc. The results could show that in such teams a psychologically safe team climate emerges from the perception of specific task-related contributions and the participation patterns of partially distributed team members. Interdependent inclusion in task-related learning activities in the early communication episodes of a team's life, enables the development of a more or less stable, psychologically safe team climate. The established climate enables inclusive task-related learning activities in subsequent task work episodes and thereby results in innovative team outcomes. Such a climate can be influenced by the structural definition of tasks which cross-cut site specific task roles (Bettencourt et al., 2007; Marcus-Newhall et al., 1993). A psychologically safe team climate reflects the affective and cognitive meanings of structural characteristics, such as interdependences, task and social categorisation processes (cf. James & Jones, 1974; James et al., 2008; Schneider et al., 2012) . This precondition fosters further risk taking and learning behaviours, in the sense of tacit beliefs (cf. Edmondson, 1999). Such a climate is more stable than team processes, and explains the discerned effect of the climate on subsequent team innovation.

According to the qualitative study, as well as the testing of the serial indirect model in the simulation study, psychological safety is an important mediator for the creation and subsequent implementation of innovative ideas. In addition to the simulation study, the field study could show that besides structural task interdependence, team leaders did influence the development of a psychologically safe team climate (cf. Detert & Burris, 2007; Walumbwa & Schaubroeck, 2009). The importance of leadership support and the allocation of time and travel resources for enabling the emergence of a psychologically safe team climate were determined. The leaders' perception and valuation of diversity characteristics were identified as important differentiating factor between the discerned global rhythms of behavioural interdependence and respective team innovation outputs. The simulation as well as the field study point towards the relevance of diversity beliefs (van Knippenberg et al., 2007), for enabling supportive social categorisation processes in developing an all-encompassing team identity. In both studies negative diversity beliefs influenced the subsequent team processes in a way that the development of identification with the fate of the partially distributed team was impeded. Furthermore, the interactions with structural forms of task interdependence (Wageman, 2001) showed differential effects of diversity beliefs. Preliminary results of the simulation study showed, that the structuring of interdependent tasks in early team episodes might attenuate the negative effect of pro-similarity beliefs (cf. van Knippenberg et al., 2007). Complementary results from the field study showed that positive diversity beliefs of project leaders were critical for enabling processes of de-categorisation. Positive diversity beliefs of team leaders lead to appreciation of the expertise from the distributed team members. Those team
members were included in early transitive team learning episodes. Through an inclusive, cooperative process (Engeström, 1992) of creating a shared goal understanding as well as further inclusion in the project, a superordinate identification with the aims of the partially distributed team could be created.

Therefore, the interaction between diversity beliefs and the organisation of task interdependences can be viewed as twofold. Firstly, with cooperative goals, which require the integration of diverse perspectives, interdependent tasks increase the valuation of diversity characteristics for respective goal achievement. Thus, interdependent tasks have an attenuating effect on individuals with negative diversity beliefs on the development of a superordinate team identity. Secondly, the diversity beliefs of leaders impact their perception of distributed expertise and consequently the structuring of task interdependences.

The findings of the field study in regard to the interaction between social categorisation processes and processes of task-related information elaboration could not be finally validated in the simulation study. The results of the field study speak for a coupling of early situated and intensively interdependent cooperative processes (Engeström, 1992) with processes of informal communication. This leads to a personalisation of the relationship and respective appreciation of the expertise of members from the other site. Such a personalisation could be interpreted as a process of de-categorisation (Gaertner et al., 1993; Gaertner & Dovidio, 2000) in which people are recognising differences in the attitudes and personalities of respective outgroup members. Processes of self-disclosure have already been identified as a critical influence factor on task-related information elaboration and subsequent decision quality in geographically distributed faultline teams in a study by Chiu and Staples (2013). The authors could show that contingent on social attraction self-disclosure reduces the salience of active faultlines. Therefore, it can be assumed that processes of informal communication facilitate processes of de-categorisation. The occurrence of processes of de-categorisation in early transitive team learning episodes could explain why team identity in terms of a re-categorisation towards a more inclusive team category, played a less crucial role in early team performance episodes. That is, the social categorisation process could be seen as a sequence of de-categorising from site specific identification patterns through personalisation, with a successive re-categorisation towards a superordinate, more inclusive team identity (cf. Gaertner et al., 1993; Gaertner & Dovidio, 2000). These preliminary findings require further empirical support.
5.2 General limitations

In both studies the focus on the concept of structural task interdependence, lead to a certain reluctance of the effect of different structural interdependences. In the simulation study, task interdependence did not show any direct effect on team identification (van Knippenberg et al., 2007). Consequently, the experiment at hand could only marginally contribute to a better understanding of the role categorisation processes in the early episodes of globally distributed task force teams. The lack of a main effect of task interdependence might be an indication that the emotional valuations (cf. Hentschel et al., 2013) are influenced by differing structural characteristics, than the structuring of task interdependences. A possible explanation might be that the rather affective reactions in social categorisation processes (cf. van Knippenberg et al., 2004) are not directly influenced by structural interdependences regarding tasks, but by the interdependence structure of goals. This argument could be supported by studies on the mitigating effects of cooperative goal interdependences on conflicts in intercultural teams (Chen et al., 2005; Tjosvold & Su, 2007).

To explain differential effects of the different forms of structural interdependence (Wageman, 2001), the idea of a dual process model in which pro-social motivations engender re-categorisations with the overarching team and mitigate conflicts, and epistemic task-related motivation engender task-related processes, should be taken into account for future empirical investigations (cf. Nijstad & De Dreu, 2012). In this study, differential effects of goal and task interdependence could not be discerned in detail due the research focus on task interdependence. The inquiry of such differential effects might be a promising avenue for future research. To extend the findings of the enabling combination of goal and task interdependences in faultline teams (cf. Rico et al., 2012) on task performance in a temporal framework, it would be very interesting to discern the effects of goal and task interdependence on task-related, as well as processes of social categorisation in respective team performance episodes (Marks et al., 2001).

In order to understand a sequential temporal process, it would be necessary to do research with more measure time points in a temporal framework (cf. Roe et al., 2012), and apply teams to work on respective projects in a meaningful time span (cf. Arrow et al., 2005, 2000). In terms of the temporal progression of success critical episodes (task implementation and review meetings), which were identified in the explorative field study, the findings of the simulation study could only partly complement the field study. As mentioned, the small sample size as well as the limited design of measurement points and manipulations of further treatment variables, did not allow for a more in-depth analysis of interaction effects in the discerned subsequent team performance episodes. According to measurement design (see Table 7) only the phase before and after the midpoint meeting were assessed. Thus, no specific changes in the processes during the review meeting could
be analysed. Such findings would be interesting in regard to changing team dynamics, which are identified as critical during episodes of reviews in the field study.

Empirical studies on effects of the subjective perception of diversity on the level of interpersonal processes, and the subsequent influence on the development of a superordinate team identity would require statistical inference estimates within a multilevel model (Chan, 1998). As the study by Hentschel et al. (2013) showed, such a model should also include emotional reactions and team affect as an important mediator variable in the development of a superordinate team identity. The presented field and simulation study provides explorative insights into the interactions between the input variables: structural task interdependences, diversity beliefs and the respective categorisation, and information elaboration in the early transitive team learning episodes of partially distributed global teams. The heuristic theoretical propositions (Kleining & Witt, 2001) allow for the development of hypothesis, which could guide such empirical endeavours.

Furthermore, differences in the relevance of the development of a shared team identity for the team outputs between the two studies, can be attributed to limitations in external validity of the simulation experiment (cf. Stone-Romero, 2004). In the students’ teams’ of the simulation experiment only a first concept for implementation had to be worked out. In the field study, real implementations of products or process improvements were the goal of the innovation endeavours. Results showed that teams' implementation episodes had a much higher relevance. Therefore, different levels of urgency in regard to task accomplishment are expected. In addition, the short time span available in the simulation study is mentioned. In the short time span of seven weeks, maybe one episode of transitive team learning could allow for the development of an innovative concept. Thus, the time required to really form a team identity was not given (cf. Lock, Funk, Doyle, & Mcdonald, 2014; Lock, Taylor, Funk, & Darcy, 2012). This could explain the lower relevance of team identity in the students' teams of the simulation study.

In both studies a certain lack of direct behavioural data for studying team dynamics in the field can be contested. The assessment of behavioural data would have been beneficial for identifying the subtleties of the dynamics, for example, in critical review meetings. In the field study, the direct observation of meetings was stopped in an early phase of the project because of privacy concerns of the involved companies. Through the involvement in critical R&D processes of the companies, such concerns had to be taken seriously. Alternatively, an assessment via a short communication feedback questionnaire was initiated. In those questionnaires the participants were asked to report their experiences just after relevant communication events. A comparable diary based method was applied in the course of the simulation experiment. In the course, which encompassed the simulation experiment students had to keep a diary, in which they reported unexpected events and reflected them in regards to the influence of defining contextual characteristics. Those results have not yet
been scientifically analysed in detail, but the preliminary evaluations of the diaries for the grading of the involved students, provided support of the findings of the statistical inference estimates of the quantitative analysis. Thus, in both studies the lack of direct behavioural data could be alleviated by the use of diary-based self-report methods.

For future studies it would be interesting to obtain more direct behavioural data, for example by assessing video data of respective meetings in field and lab settings (see Lehmann-Willenbrock, Meyers, Kauffeld, Neininger, & Henschel, 2011 for a respective lab study). Moreover, the use of experience-based sampling methods (Kubey, Larson, & Csikszentmihalyi, 1996; Larson & Csikszentmihalyi, 1983) could allow for random sampling in naturalistic contexts of individual perceptions of team states and processes, especially in regards to emotional valuations (cf. Ashkanasy & Humphrey, 2011; Hentschel et al., 2013). Since the beginning of the millennium, different tracking tools are able to quantitatively and semantically track online activities, for example, by assessing email and calendar activities (Begole, Tang, Smith, & Yankelovich, 2002, Fisher & Dourish, 2004). This provides interesting ways for assessing more direct behavioural data. Modern mobile tools offer even more opportunities for tracking and assessing direct behavioural data from the field (cf. Muukkonen, Hakkarinen, Li, & Vartiainen, 2014; Rana, Hume, Reilly, Jurdak, & Soar, 2015). However, such methods should also be considered in regards to legitimate privacy concerns of the involved research subjects. Methods which allow for informed participation of users, for example, via social media applications are promising for gathering data to include the concerns of the users for respective organisational and tool-oriented designs (cf. Klammer, van den Anker, Froehlich, & de Groote, 2014).

In relation to the explorative nature of this research, both studies have relatively small sample sizes. The samples were used to gain early insights into the influence of structural task interdependence on team dynamics in respective team performance episodes. Thus, the findings have to be seen as a first exploratory identification of relationships that have to be tested in further empirical studies with bigger samples, in a more deductive research perspective. However, following the heuristic-explorative research frame (cf. Blumer, 1956; Kleining & Witt, 2001), in both studies the use of samples was oriented on a principle of variation of perspectives. This allows for a broader generalisation in regards to the involved fields of application. Likewise, the use of the principle of maximal variation of perspectives was also applied to integrate different kinds of data in the analysis. The initial, more explorative-qualitative approach and a more quantitative approach in the subsequent study allowed for a generalisation of results across different research methods. Thus, the

\[\text{2 In the field study using maximal variation of the defining characteristics and in the experimental simulation using students from different Universities with differing disciplinary backgrounds was varied.}\]
overall design allows to some degree of generalisation of the convergent results for innovation triggering effects of structural task interdependence in early team performance episodes in both studies (Stone-Romero, 2004).

Complementary to the reduction of testing, the influence of structural task interdependence in early team work episodes in the simulation study, the field study provides a holistic framework for understanding interdependence dynamics over the whole span of an innovation cycle of a team. The field study enables further insights with regard to the identified subsequent team performance episodes, with heuristic potential for developing theory (Kleining & Witt, 2001). Therefore, in the following subchapter an episodic model (Marks et al., 2001) of global interdependence dynamics that promotes team innovation in globally distributed contexts will be developed.

5.3 Towards an episodic model of categorisation-elaboration in partially distributed global teams

The explorative, heuristic study (Kleining & Witt, 2001) in combination with an understanding of teams as open, complex and temporally dynamic systems (Arrow et al., 2005, 2000) provided a holistic framework for understanding interdependence dynamics which contribute to innovative team outputs. The framework enabled the development of propositions for global dynamics in innovation projects, as well as local dynamics of information elaboration and social categorisation processes (van Knippenberg et al., 2004) in specific team performance episodes (Marks et al., 2001). It has to be emphasised here, that the holistic explorative research paradigm of the qualitative cross-case study adds to the understanding of global dynamics as outlined in the open, complex, adaptive system theory by Arrow et al. (2000). By following through whole innovation endeavours in eleven teams three global interdependence dynamics could be identified. These can be compared to overarching organisational structures, structural interdependences, and respective attitudes and diversity beliefs of the involved project leaders. Therefore, the impact of contextual factors, especially in regards to the influence of structural task interdependence, which act as attractors for stable global interdependence dynamics on the level of the team was analysed. The global rhythms were structured by three discriminable team performance episodes: transitive team learning, review meetings, and implementation. In those episodes respective subgoals had to be achieved, and feedback became available (cf. Marks et al., 2001).

According to the overarching rhythms the local dynamics in the discerned task work episodes were structured by particular dynamics of behavioural interdependences in cooperative as well as coordinative task work processes (cf. Engeström, 1992; van de Ven et al., 1976). These were tightly coupled to processes of social categorisation. The coupling of processes of task-related information
elaboration with enabling processes of social categorisation (cf. van Knippenberg et al., 2004) in the episodes will be outlined as differential characteristic of the respective team performance episodes.

5.3.1 Global interdependence dynamics structured by team performance episodes

Ancillary to the proposed interactions of contextual enablers on the distinguished levels, the explorative field study provides evidence for differential patterns of behavioural interdependences (Wageman, 2001) during team performance episodes (Marks et al., 2001). The discerned global interdependence dynamics in the field study were influenced by social entrainment effects in the early episodes of a teams’ life. In line with the findings by Kelly et al. (1990) the importance of framing initial team episodes as capability problems, by giving the resources to slow down for enabling reflexive communication processes (cf. Engeström, 1992), was important for facilitating team innovation.

In addition to research on social entrainment in teams, the field study proposes that the teams have to learn their most complex cooperative interdependence dynamics at the beginning of a teams’ life, in order to be enabled to repeat respective patterns later on. For example, the teams’ under the polyrhythmic pattern learned processes of reflexive communication in f2f-settings in the first team performance episodes. This pattern involved highly intensive, synchronous interdependences (cf. van
de Ven et al., 1976), which allowed for the identification of relevant contextual information and reflexive, co-constructive communication processes (Engeström, 1992). Such transition episodes (see Figure 9) can be conceptualised as team learning processes (cf. Edmondson, 1999).

In line with more recent empirical evidence (Wiedow & Konradt, 2011) transition episodes are conceptualised by two dimensions including reflexion and adaptation. The discerned team learning episodes in the field study involved reflexive communication processes (Engeström, 1992), which were supported by highly intense and synchronous task interdependences (in the field study mostly in f2f settings), and processes aimed at adaptation. Furthermore, processes of exploration of solutions could be discerned, which required more parallel processing in cross-site expert teams, whereas reflexive processes involved more convergent communication processes in synchronous media settings (cf. Dennis et al., 2008). Teams, which entrained such transitive team learning episodes were able to repeat them in case of unexpected dynamics, which required an adaption of the goals.

Teams, which entrained highly interdependent patterns in transitive team learning episodes experienced transitions similar to those identified in the studies by Gersick (1983, 1988, 1989). Typically, such transitions occurred between two milestones. In contrast to the findings in Gersick's studies, the transitions were not perceived as punctuated events. They were rather influenced by unexpected events, which interrupt the flow of coordinated activities. Such unexpected dynamics or events triggered processes of reflexive communication (cf. Engeström, 1992) in the transitive learning episodes, which structured the polyrhythms of more innovative teams. Such polyrhythms engendered a process of adaption of former concepts. In phases of interdependent work new possible solutions were worked out and evaluated in distributed expert circles. In line with the study by Harrison et al. (2003), teams were enabled to switch between already entrained episodes, when task requirements changed. It is suggested here that the entrained pattern of interdependence required for transitive learning episodes can be repeated in later phases, when similar requirements for the reduction of equivocality occur.

On the lowest level of required behavioural interdependences (Wageman, 2001), episodes in which the primary goal was the implementation of established specifications could be discerned. When a work orientation could be established, adaptive processes were restricted to coordinative feedback modes (van de Ven et al., 1976). Such task implementation episodes can be compared to the action episodes identified by Marks et al. (2001). In implementation episodes the goals are set and the main purpose is to execute tasks effectively. Task work processes, such as task clarification and understanding, continuous coordination and feedback, structure the interdependences in the process of execution. To enable switches in implementation episodes towards more reflexive modes, it is important to keep reciprocal task-related interdependences across sites. For example, by
explicitly planning, or more implicit coordination means, such as shared orientation for coordinated task work (cf. Espinosa et al., 2002). The criticality of interdependences, which cross site specific member roles (Bettencourt et al., 2007), was shown for the required shared awareness of task progress and directions across sites. Similar to the dynamics observed by Maznevski and Chudoba (2000), prescheduled reviews did have a respective impact on the global interdependence dynamics in the partially distributed teams under study. Review meetings as prescheduled events or ‘zeitgebers’ (McGrath & Kelly, 1986) had an impact on team entrainment in phases of coordinated group activities. They can be conceptualised as a differential team performance episode (cf. Marks et al., 2001), which serves the goal of adjustment in regard to a pre-set goal state in front of a public of relevant stakeholders. Requirements for reciprocal task interdependences in processes of gathering the results for the presentations and post-processing received inputs from external experts were increased. The review events itself represent evaluative communication processes integrating a public of respective expert reviewers external to the operative team. Thereby, they involve synchronous attention towards achieved goals. Cooperative processes (Engeström, 1992) are defined by external or internal dynamics, which require a certain degree of equivocality reduction (Daft & Macintosh, 1981) and adaptions regarding the planned work process. The higher amount of equivocal information regarding possible solutions requires convergent communication processes in synchronously interdependent tasks (cf. Dennis et al., 2008), which enable integrative decision making (cf. Janssens & Brett, 2006). Such review processes were the highest order cooperative processes in the recurring review meeting rhythms. Thus, allowing for respective adaptions in the means to achieve the pre-set innovation objectives. As will be outlined in the following subchapter, the study allowed a further elaboration of the relation between social categorisation and task-related information processing (van Knippenberg et al., 2004) in the identified team performance episodes which enable innovation.

5.3.2 Local categorisation-elaboration dynamics and emerging team climates

In the temporal framework of team processes Marks et al. (2001, pp. 368), differentiate interpersonal processes, which 'typically lay the foundation for the effectiveness of other processes'. Besides the thesis that interpersonal processes may act as support of task-related processes in transition and action episodes, they stay rather vague in regard to type or direction of relationships between task work processes and the described interpersonal processes. In the proposed heuristic model (Kleining & Witt, 2001), the specification of the relationships between social categorisation processes and processes of task-related information processing in the discerned episodes is claimed. Event though, this study had a clear focus on team processes, the results of the empirical studies also provide evidence in regard to emerging team states, which support team processes in respective
episodes. In line with the arguments developed by Marks et al. (2001) the discerned team performance episodes should be differentiated from so-called emergent states (Ilgen et al., 2005; LePine et al., 2008), which characterise properties of the standing group (McGrath, 1984). According to the results of the field study, it is suggested, that such team states consist of the emotional and cognitive perception of the coupling of task-related information processing and social categorisation processes. In the following, local dynamics of categorisation and information processing will be outlined, which enable the emergence of prolific team states for innovation.

As outlined in the field-simulation study comparison (see chapter 4.1) the reflexive and cooperative task work processes in early episodes of transitive team learning, are hypothesised to be coupled with processes of ‘learning to know’ the persons and the respective expertise from team members from the other site (Kanawattanachai & Yoo, 2007; Maynard et al., 2012). It is supposed that highly cooperative processes (Engeström, 1992), which require shared attention towards future innovation objectives should be accompanied by enough space for informal interpersonal communications. As reported in the qualitative field study, time and resources for meeting in f2f-settings enabled not only interpersonal liking, but also the discovery of distributed expertise. On an interpersonal level, such processes were already shown to be coupled with processes of self-disclosure and affect-related responses in regard to interpersonal liking (cf. McCroskey et al., 2006). In vein with the study by Chiu and Staples (2013) processes of self-disclosure regarding respective expertise, seem to be directly linked to processes of task-related information elaboration (van Knippenberg et al., 2004).

Furthermore, in a de-categorisation perspective (Gaertner & Dovidio, 2000) the decrease of the salience of respective diversity characteristics, lead to less impact of respective diversity faultlines (Thatcher & Patel, 2011). This enables an interaction on an interpersonal level in which stereotypical perceptions of outgroup members as well as the intergroup bias have less impact (cf. Gaertner & Dovidio, 2000). As the study by Meyer et al. (2011) showed, such a decrease in category salience, moderates the impact of diversity faultlines on task-related information elaboration. These insights provide more evidence for the importance of accompanying reflexive cooperative processes with informal, interpersonal processes, which allow for a de-categorisation from site-specific identification patterns in transitive learning episodes (cf. Gaertner & Dovidio, 2000).

In line with the de-categorisation argument (cf. Gaertner & Dovidio, 2000), it was not team identity which emerged from the early interactions in transitive team learning episodes, but rather a climate which embraced diversity, different perspectives and critical thinking. In the partially distributed global teams, the emergence of a psychologically safe team climate (Edmondson, 1999) emerged from the perception of reflexive processes of information elaboration coupled with social processes of de-categorising site specific identities. As the empirical tests in the simulation study could show, it is such a team climate that mediates the effects of task interdependence on team innovation.
Therefore, it is assumed that the interplay of social processes of self-disclosure and personalisation, which support de-categorisation, with team learning processes involving high degrees of task elaboration enable the emergence of a psychologically safe team climate. Such a climate then acts as a disposition for further team learning episodes to occur throughout the process of innovation.

In the implementation episodes, the importance of structuring task interdependences across sites in regard to expertise role assignment could be identified as critical. In line with the cross-cut task role assignment argument (Bettencourt et al., 2007; Marcus-Newhall et al., 1993), it is proposed that structuring task interdependences across sites decreases site specific category salience. Thus, interactions on an interpersonal level are enabled (cf. Meyer et al., 2011), which are prolific for respective information processing in teams. Such processes are believed to reinforce de-categorisation from site specific affiliations.

Furthermore, a higher demand for coordination and information exchange as well as reciprocal feedback processes (cf. van de Ven et al., 1976) require the development of shared orientations for coordinated interaction. In implementation episodes the emerging perception of the standing group (McGrath, 1984) changed towards the development of shared norms and rules for coordination processes. Such a shared, implicit understanding of coordinated activities can also be compared to so-called hybrid cultures. Such hybrid cultures are defined by Earley and Mosakowski (2000, pp. 27) as a shared set of ‘emergent and simplified set of rules and actions, work capability expectations, and member perceptions’.

It is proposed that coordinated and interdependent activities should enable the development of such a shared set of norms through a sense of embeddedness in interdependent interactions. This aspect of embeddedness in interdependent interactions is also mentioned in the literature on collective identity (see Ashmore, Deaux, & McLaughlin-Volpe, 2004 for a comprehensive review of differential aspects of collective identity). Therefore, it can be assumed that assigning task roles across sites (Bettencourt et al., 2007) enables the development of shared rules and norms for coordinated interactions through the embeddedness in a dense network of frequent interdependent interactions.

In relation to differential aspects of team identity, such norms and rules can be viewed as a behavioural aspect of team identity (cf. Heere & James, 2007). It is proposed, that creating interdependent coordinated interactions across sites, should foster the development of a dimension of team identity, therefore enabling a re-categorisation towards a more inclusive entity (Gaertner & Dovidio, 2000).

Team identification (Ashmore et al., 2004) can be further reinforced during the discerned review episodes, through social processes of alignment towards shared innovation objectives. Synchronous processes (cf. Dennis et al., 2008) of results presentation and evaluation in front of experts, are assumed to enable processes of re-categorisation towards the partially distributed team (Gaertner &
Dovidio, 2000). An important difference between the recurring review rhythm and the polyrhythm could be identified in the degree of inclusion of the engineers from the dispersed site in the review presentation process. Especially in the case of the polyrhythmic pattern more inclusive social processes were practiced (for example presentation of results of dispersed experts). Such practices resulted in a stable identification with the teams' aim. It is proposed here that the intragroup situation changed to an intergroup situation in which an evaluative comparison with comparable teams is primed (cf. Haslam, 2004). Such a change towards an intergroup situation will amplify the identification with the fate of the partially distributed team. The evaluative and representative aspect of identity, as identified by Ashmore (2004) can be seen as being related to the presentation and legitimation of the achieved work state, in front of respective stakeholders of the project. In line with research on team identity (cf. Heere & James, 2007; Lock et al., 2012), it could be fruitful to differentiate respective aspects of team identity, which emerge in the distinguished team performance episodes.
5.4 Theoretical implications

First of all the studies extend the proposed four principles of structural task interdependence (principle of task allocation, rules of process instructions, trait of technologies, and principles of resource distribution) by Wageman (2001). Regarding the principle of task allocation, the model proposes three differing types of task allocation, which lead to differential global dynamics of behavioural interdependences in the process of meaningful team projects. Most importantly, the interdependent allocation of tasks requiring interdependences throughout the entire project was distinguished as prolific for team dynamics, which enable innovative team outcomes. Furthermore, the temporal structuring of the reduction of equivocalities (Daft & Macintosh, 1981) during the innovation projects, could be discerned as influencing behavioural interdependences in the process of the task work. In relation to the perception of competence distribution in the settings of the global teams (Wageman, 2001), diversity beliefs of involved team leaders (van Knippenberg et al., 2007), and respective centralization of the R&D organisations (cf. Mendez, 2003; von Zedwitz & Gassmann, 2002; Zeschky et al., 2014) differences in the integration in early transitive team learning episodes, could be identified. The involvement of members from dispersed locations in f2f environments in such episodes is perceived as critical for enabling team level innovation in the distributed setting. The developed propositions of the heuristic model could be tested by manipulating task interdependences in the formal process instructions of the involved students teams in the experimental simulation. In line with the arguments by Wageman (2001), different aspects of task interdependence such as the distribution of resources, the traits of used technologies as well as formalized process instructions have to be analysed in interaction with each other in order to understand their influence on behavioural interdependence. Furthermore, according to the developed heuristic model, it is claimed that they have to be analysed in relation to the organisational structures (degree of centralisation) and the aspects like diversity beliefs (van Knippenberg et al., 2007) on the individual level to understand their impact.

The identified team performance episodes can be seen as an endorsement of the framework developed by Marks et al. (2001). The grounded team performance episodes can be viewed as recurring phases or cycles in which specific goals direct team actions. Thus, team processes can be viewed as a series of related I-P-O process cycles (McGrath, 1984), defined by requirements for task interdependences, and task-related information processing. As in the proposed framework by Marks et al. (2001), the relation between team performance episodes and task-related information processing is not seen as deterministic. Described task work processes are not necessarily bound to specific episodes, but are seen as supportive for achieving the subgoals of the respective I-P-O cycles (McGrath, 1984). The distinguished implementation episodes can be compared to the action episodes and requirements for coordination in the framework by Marks et al. (2001). Transitive
episodes have been further distinguished, in regard to the differentiation between planned and unplanned reflexive transitions in teams. The qualitative-heuristic field study (Kleining & Witt, 2001), can be seen as exceptional in regard to the substantive identification of respective team performance episodes (Glaser & Strauss, 1967).

It is claimed here that the identified team performance episodes can be differentiated according to their requirements for cooperative or reflexive communication (Engeström, 1992). In implementation episodes communication can proceed by the exchange of task boundary conditions. Smaller changes might include the corrective adaptions through coordinative modes involving reciprocal feedback processes between group members (van de Ven et al., 1976). As long as they stay in the predefined coordination structures, the teams' stay in their mode of coordinated goal directed action (cf. Wehner et al., 2000). Prescheduled review meetings lead to an evaluative comparison of the achieved goal state with the planned project objectives. Therefore, the activity mode changes towards cooperation in which members are required to evaluate, and if necessary, adapt their plans and scripts for interaction to achieve the pre-set goals. Such a cooperative mode (Engeström, 1992) requires openness towards external evaluations, to assure that project stakeholders accept developed solutions. The cooperative process involves evaluations of equivocalities in the actual goal state by converging towards a shared understanding (cf. Daft & Macintosh, 1981). More expansive cooperation cycles, in the field study, were caused by unexpected events and dynamics in the distributed environment of the teams. Such dynamics triggered elaborations of the innovation objectives and thereby enabled disruptive change. In line with studies on the influence of unexpected events for triggering team learning episodes (cf. Oertel & Antoni, 2014; Zellmer-Bruhn, 2003), it is assumed that unexpected dynamics are important for reflexive co-constructive modes (Engeström, 1992; Wehner et al., 2000). From an information processing perspective the discerned team performance episodes can be related to requirements of processing or elaboration of task-related information (Nijstad & De Dreu, 2012). Information processing requirements can be seen as increasing in complexity from ...

- the coordinated interactions (van de Ven et al., 1976) in the implementation episodes,
- to the evaluative processes in the reviews, and
- towards the reflexive perception and elaboration of differences in transitive team learning episodes (Engeström, 1992).

In line with recent theoretical arguments (Schippers et al., 2015) on team reflexivity and information processing failures, it can be argued that each episode has its own fallacies. In implementation episodes the failure to search for and share information can impede, coordinated interaction
processes. During review episodes, failures to revise and update the actual state of work should be undermined. Therefore, stepping out of habitual routines (Gersick & Hackman, 1990) and entrained coordination practices enables a more reflexive stance. In the review meetings, the achieved goal state has to be gathered for presentation in front of external experts. It therefore becomes necessary to change the pace of coordinated activities. Forcing the team members to present and reflect upon their decision process in a context which takes them out of the ordinary work setting, enables teams to surmount the fallacy of not being able to revise and update their decision making processes. In transitive team learning episodes the failure to recognize relevant discrepancies and to elaborate on them is seen as central impediment. Therefore, information elaboration should be grounded in concrete examples and data, it should be assured that respective data are questioned and different opinions are raised, and that processes of exploration and evaluation of early solutions are balanced.

In line with an information processing approach (cf. Schippers et al., 2015), the task work processes of the discerned team performance episodes can be seen as structuring element for mitigating failures of information processing in more complex, innovative projects. Finally, the developed heuristic theoretical model extends the categorisation-elaboration model developed by van Knippenberg et al. (2004), by integrating a common ingroup identity perspective (Gaertner & Dovidio, 2000) with an episodic team performance model (Marks et al., 2001). Grounded in the results of the explorative study, it is proposed that partially distributed teams are required to de-categorise from site specific identities in early transitive team learning episodes. Such processes should create the possibility to learn from each other’s’ expertise under an emerging psychologically safe team climate (Edmondson & Lei, 2014). Moreover, they are required to re-categorise towards the superordinate category of the partially distributed global team, through the coordinated interaction in implementation episodes, as well as by representing achieved team outputs in front of project stakeholders in review episodes. Therefore, a process of de-categorisation from site specific identity affiliations in transitive team learning episodes, and episodic dynamics of re-categorisation in implementation and review episodes is proposed.

5.5 Practical implications - Team performance episodes for a socio-technical development of partially distributed global teams

Besides the heuristic value of the proposed episodic model for the identification of interactions between information processing and social categorisation processes, the model could prove its heuristic potential for managing dynamics in partially distributed global teams. The proposed team performance episodes were used in the extended field study in the validation and development phase (see Table 2). This enabled the development of team dynamics according to the goals of the
project. In workshops with teams in the selected cases, the framework could be further developed to enable an optimal choice of cmc media and tools for supporting task-related information processing (cf. Dennis et al., 2008). The developed episodes were used as a frame for developing socio-technical scenarios to improve process dynamics (Anker & Schulze, 2006).

The proposed interactions of task-oriented information processing with social categorisation processes, enabled a joint optimisation of social and more task-oriented processes (Emery & Trist, 1969). Small improvements were planned and implemented with the members of the involved teams. In one example, the simple introduction of an instant messaging tool enabled more spontaneous and informal communication, which was particularly important for facilitating transitive team learning episodes. Respective social norms and rules for interactions were developed to support teams to achieve the sub goals of the supported episodes. For enabling transitive team learning, rules in regards to activate an elaborated exploration process were set. This participative process included the engineers from both sites in a topic-oriented discussion forum.

The results of the qualitative field study showed that team leaders still rely on f2f contacts during phases requiring intensive and synchronous interdependences (Dennis et al., 2008). It is proposed, that the important accompanyng informal communication processes are quite difficult to support in distributed settings, as most of the tools support more formal meeting settings. Short informal discussions, before or after such meetings, are still prone to the site-specific subgroups, which might reinforce categorisation into a ‘us vs. them’ structure (cf. Gaertner & Dovidio, 2000). Thus, interrupting task-related information elaboration required for innovation. Further applied research is required to develop media environments, which allow for better support of informal communication processes in distributed settings (cf. Schulze, Burkhard, Knöpfli, Mateescu, & Ryser, 2014). Even though, some applications (for example 3D glasses) might be already quite developed in regard for transferring social cues not only through audio channels (cf. Bosch-Sijtsema & Haapamäki, 2014), a broader distribution in business settings, might need more time. According to the results of the field study, it still seems more effective to collocate teams to enable team processes requiring reflexive cooperation (Engeström, 1992).

In contrast to established and institutionalised practices (for example PMbok, and IPMA standards of project management) of project KickOffs with a strong focus on coordinative processes (for example planning and scheduling of milestones), it seems more important to structure early f2f contacts in open meeting contexts, with some flexibility in regard to time and work resources. The focus should be on understanding contextual issues and differences (cf. Cramton, 2002). Processes should enable the appreciation of respective differences as innovative contribution to a shared future objective (cf. Holman, Devane, & Cady, 2007). Even though, there is already a vast amount of comparable methods for enabling teams to be creative (cf. Burow, 2008; Sonnenburg, 2004), the proposed heuristic model
provides further support to enable contacts on an interpersonal level. It also supports the appreciation of differences, before striving for an identity based on shared goals. Besides the claim for early open f2f meetings in the respective contexts, it offers concrete hints for media support of respective task work processes throughout critical transitive team learning episodes. Besides the importance of initial socialisation and entrainment (McGrath & Kelly, 1986), methods developed for data assessment and analysis, such as the project lifelines (Moldaschl, 2009) can be used to reflect the dynamics in practice. In line with the propositions by Schippers et al. (2015), practices were established in the development phase of the field study, which should engender short reflexions about the quality of information exchange and coordination. As such, a five minutes team feedback session can be perceived as impediment for information processing fallacies (see chapter 5.4). Such practices are widespread through project management methodologies in extreme programming and scrum project management as applied in distributed software development projects (X. Wang, Conboy, & Pikkarainen, 2012). In the industrial setting of the applied research project, however, such practices were difficult to maintain due to the dynamic environments of the organisational R&D teams. Nevertheless, besides already established review episodes with their own dynamics, practices of short reflexive interventions could be a good remedy for loosing synchronicity (Dennis et al., 2008) during implementation episodes. Finally, the proposed course concept which structured the simulation study, involving a phase of reflexion after the co-evolving project phase with the Indian students (cf. Fenwick, 2006), was guided by the developed heuristic framework of episodic team work processes. Reflexive parts were structured by the identification of unexpected dynamics in the distributed context and in regards to task equivocalities (Daft & Macintosh, 1981). Furthermore, the students were instructed to analyse episodes structured by sub goals in their project endeavours and subsequently use them for socio-technical improvements (Anker & Schulze, 2006). In a heuristic perspective (Kleining & Witt, 2001) the dialogue with the students allowed for the further elaboration of respective hypothesis through the use of qualitative data of their inquiry. Therefore, dedications to the students participating in the course have to be highlighted for enabling this contribution. Furthermore, the concept enabled the development of particular competences for collaboration in distributed global team contexts (Ryser, Ganesh, Moreno, & Schulze, 2011). Hence, the heuristic episodic team model, could be proven to be valid for structuring courses to develop students' collaboration competences in directions of a more participative global citizenship.
Literature


Appendix

Appendix A - Template for sketching the project lifelines
Appendix B - Interview coding scheme - codes primary documents table from Atlas.ti (study 1)
Appendix C - General task descriptions simulation experiment
Appendix D - Manipulation of the treatment variable task interdependence
Appendix E - Assumptions and requirements for statistical inference testing
Appendix F - Descriptives and Cronbach’s Alpha scales
Appendix G - Descriptives and interrater agreement team variables
Appendix A - Template for sketching the project lifelines

<table>
<thead>
<tr>
<th>High</th>
<th>Intensity of communication</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Structuring events in the project phases (e.g. Kickoff, Milestones, Feedback, unplanned events)</td>
<td>5</td>
</tr>
</tbody>
</table>

Please sketch the project life-cycle according to the following questions:
1.) First, please draw a line for the intensity of communication between … and … throughout the project….
2.) Second, please indicate crucial events for this project according to specific phases.

- Name of project: ??
- Name of project leader: ??
- Project start Date: ??
- Close out Date: ??
## Appendix B - Interview coding scheme - codes primary documents table from Atlas.ti

<table>
<thead>
<tr>
<th>Codes</th>
<th>Primary Documents Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD 1</td>
<td>case 1 team 5008 (IND)</td>
</tr>
<tr>
<td>PD 2</td>
<td>case 1 team 5008 (CH)</td>
</tr>
<tr>
<td>PD 3</td>
<td>case 1 team 2187 (IND)</td>
</tr>
<tr>
<td>PD 4</td>
<td>case 2 team J2 (HR)</td>
</tr>
<tr>
<td>PD 5</td>
<td>case 2 team J2 (HR)</td>
</tr>
<tr>
<td>PD 6</td>
<td>case 2 team 2193 (CH)</td>
</tr>
<tr>
<td>PD 7</td>
<td>case 2 team 2187 (REV)</td>
</tr>
<tr>
<td>PD 8</td>
<td>case 2 team J2 (MR)</td>
</tr>
<tr>
<td>PD 9</td>
<td>case 1 team 1122 (IND)</td>
</tr>
<tr>
<td>PD 10</td>
<td>case 1 team 1122 (REV)</td>
</tr>
<tr>
<td>PD 11</td>
<td>case 1 team 1122 (FED)</td>
</tr>
<tr>
<td>PD 12</td>
<td>case 2 team 2187 (FED)</td>
</tr>
<tr>
<td>PD 13</td>
<td>case 2 team 2187 (CH)</td>
</tr>
<tr>
<td>PD 14</td>
<td>case 2 team 2187 (REV)</td>
</tr>
<tr>
<td>PD 15</td>
<td>case 2 team J2 (CH)</td>
</tr>
<tr>
<td>PD 16</td>
<td>case 2 team 2193 (CH)</td>
</tr>
<tr>
<td>PD 17</td>
<td>case 2 team 2193 (REV)</td>
</tr>
<tr>
<td>PD 18</td>
<td>case 1 team 2187 (CH)</td>
</tr>
<tr>
<td>PD 19</td>
<td>case 1 team 2187 (REV)</td>
</tr>
<tr>
<td>PD 20</td>
<td>case 1 team 2187 (REV)</td>
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<tr>
<td>PD 21</td>
<td>case 1 team 1122 (FED)</td>
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<tr>
<td>PD 22</td>
<td>case 1 team 1122 (REV)</td>
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<tr>
<td>PD 23</td>
<td>case 1 team 2193 (FED)</td>
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<tr>
<td>PD 24</td>
<td>case 1 team 2193 (REV)</td>
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<tr>
<td>PD 25</td>
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<tr>
<td>PD 26</td>
<td>case 1 team 2187 (REV)</td>
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<tr>
<td>PD 27</td>
<td>case 1 team 2187 (REV)</td>
</tr>
<tr>
<td>PD 28</td>
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<td>PD 29</td>
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<tr>
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<tr>
<td>PD 33</td>
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<td>PD 34</td>
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<tr>
<td>PD 35</td>
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<td>PD 36</td>
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<td>PD 39</td>
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<tr>
<td>PD 40</td>
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<tr>
<td>PD 41</td>
<td>case 2 team 2187 (REV)</td>
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<tr>
<td>PD 42</td>
<td>case 2 team 2187 (REV)</td>
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<tr>
<td>PD 43</td>
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<tr>
<td>PD 44</td>
<td>case 2 team 2187 (REV)</td>
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<tr>
<td>PD 45</td>
<td>case 2 team 2187 (REV)</td>
</tr>
<tr>
<td>PD 46</td>
<td>case 2 team 2187 (REV)</td>
</tr>
<tr>
<td>PD 47</td>
<td>case 2 team 2187 (REV)</td>
</tr>
<tr>
<td>PD 48</td>
<td>case 2 team 2187 (REV)</td>
</tr>
</tbody>
</table>

*TOTALS: 173 54 189 103 72 83 73 59 238 101 21 90 30 50 95 30 74 47 1642*
Appendix  C - General task description with the same structure for all treatment groups

**Structure of tasks for the intercultural students course**

<table>
<thead>
<tr>
<th>Structuring collaborative task student course</th>
<th>Deliverables</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.) Introduction in the planned collaboration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.) Team coordination</td>
<td>Assignment of team coordinator</td>
<td>25th of February 2013</td>
</tr>
<tr>
<td>a) Getting to know each other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Appointing and selecting a team coordinator, to achieve optimal coordination of the team processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Writing of a project plan and concrete task coordination</td>
<td>Upload Project plan in projectplace</td>
<td>4th of March 2013</td>
</tr>
<tr>
<td>3.) Requirements analysis and market analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Groups work on the requirements for developing a training/ policy program for the defined target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Identification of similarities in the context of the countries regarding the topics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.) Status report (in Plenum) to present</td>
<td>Requirements and target group analysis</td>
<td>18th of March 2013</td>
</tr>
<tr>
<td>a) Presentation of Project plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Presentation of the requirements for a training or policy program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Feedback and exchange of ideas for the training/ policy program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.) Final design of the program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Design of the programs approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Concrete implementation design of a training/policy program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.) Final meeting</td>
<td>Training or policy program</td>
<td>15th of April 2013</td>
</tr>
<tr>
<td>a) Presentation of programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Ranking of creativeness of proposed solutions</td>
<td>Presentation of detailed methods</td>
<td></td>
</tr>
</tbody>
</table>
Process descriptions for Interdependent Teams

Specifications for the requirements analysis (till Apr 18th 2013)

Your general task is to make requirements analysis regarding the training or policy program regarding life-domain-balance issues in the context of the boundary spanning virtual work situation.

- **Identify critical beliefs, attitudes and typical behaviours that may lead to stress in virtual work settings**
  It is very important to know about the possible beliefs and attitudes that may lead to stress which are comparable in the employees of both countries. The identification of concrete situations in which stress symptoms occur may help to identify underlying causes and malfunctioning beliefs and assumptions. Collect such critical beliefs, attitudes and behaviours that your think are important to address in your training or policy programs.

- **Segment your target groups and identify high risk groups for your training or policy programs**
  Different subgroups in the group of employees engaged in the virtual work setting may endorse different perspectives regarding issues of work-life-balance. It seems important to differentiate between target groups and target your training or policy program accordingly. Your training or policy program budget will be much more cost effective if you address the change in high risk groups.

- **Research for methods and modules regarding trainings and policy programs**
  Such methods can be found in the reference collection of any public library or college library that supports local business or a business school.
Process descriptions for independent teams:

Specifications for the requirements analysis (till March 24th 2014) - Independent teams

**Step 1:** Your first task will be to make requirements analysis regarding the training or policy program for the target group for the organizations in each country.

- **Identify critical beliefs, attitudes and typical behaviours that may lead to gender issues in your home country**
  It is very important to know about the possible beliefs and attitudes that may lead to gender issues in your country. The identification of concrete situations in which gender clashes occur may help to identify underlying assumptions, beliefs and values. Collect such critical beliefs, attitudes and behaviours that you think are important to address in your training or policy programs.

- **Segment your target groups and identify high risk groups for your training or policy programs**
  Different subgroups of your country may endorse different perspectives regarding gender issues. It seems important to differentiate between target groups and target your training or policy program accordingly. Your training or policy program budget will be much more cost effective if you address the change in such high risk groups.

- **Research for country specific methods and modules regarding trainings and management programs**
  Such methods can be found in the collection of any public library or college library that supports local business or a business school.

**Step 2:** Appoint a meeting after you have made the first country specific requirements analysis and present the results of your analysis to your team mates uproad via the sharepoint workspace.

**Step 3:** Try to find similarities between the target groups and the requirements for the training or policy program in both countries to sketch a first draft for a program which addresses common topics in the cross-national setting.
Appendix E - Assumptions and requirements for statistical inference testing

To test for mediation as well as moderation hypothesis, methods based on ordinary least square (OLS) regressions were chosen. Even though SEM might be preferable for correcting for random measurement errors in latent variable models, because of the sample size of the study, OLS regression based methods for estimating statistical inferences were chosen (cf. Hayes & Scharkow, 2013). Consequences for the test of assumptions at hand are discussed in more detail below for each requirement for interpretation of statistical inference.

**Independence.** The not entirely randomized experimental procedure leads to some problems with the assumption of data independence. The test on the level of treatment groups is seen as a rather conservative test of the posited statistical hypothesis. Furthermore in the experimental design, team level dynamics were cross-checked, with the assessment of critical events in diary studies of each team to get a better understanding of team specific dynamic effects of treatment as well as non-treatment effects.

**Normality.** The method of variance analysis as well as OLS based regression analysis requires a normal distribution of variances. The assumption of normality of error terms is seldom tested in OLS based regressions, because, according to simulation based studies, the OLS based models are only sensitive to severe violations of the normality assumption (cf. Hayes, 2013). For checking the normality of error variances, the normal distribution of the involved scales was checked regarding their skeweness and kurtosis. All the scales were in an acceptable range of values between 2 and -2 regarding skewness and below the acceptable range of 10 in kurtosis assuming normality of the error term distribution.

**Homogeneity of conditional variances.** In the regression based models the homogeneity of conditional variance is also called the assumption of homoscedasticity, meaning that the errors in the estimation of Y are equally variable on conditioned on Ŷ (predicted value of Y). When the condition is not met, the errors are heteroscedastic and the differences are probably influenced by another variable, which is not included in the model. For OLS regression based analysis, homoscedascticy can be tested visually by eyeballing a scatterplot of the residual in function of Ŷ (cf. Hayes, 2013). Such tests were considered for the regressions analysis based inference tests in this project.

In covariance based models the homogeneity of a further conditional variance has to be taken into account: the treatment group conditional variance on Y (cf. Huitema, 2011). These variance should be equal in all of the assessed treatment groups as well.

**Linearity.** As the OLS regression based models assume a linear relationship between a predictor variable X and an independent or outcome variable Y, the distribution of observed X and Y variables should be checked for linearity. This means that a move of one unit on thee X-axis Y should always be function of the regression coefficient b. In case of violation of the linearity assumption the
interpretation of the regression coefficients is flawed. This assumptions was checked by visually analyzing the scatterplots of the single regressions involved in the mediation or moderation hypothesis of the study (cf. Hayes, 2013).

The problem of multicollinearity. In models with several predictor (multiple regression models) one has to check for the multi-collinearity. In the case of multi-collinearity the variances of the predictors overlap, leading to redundancies of the effects of the predictor variables. Thus separate effects of specific predictors cannot be discerned. To check for multi-collinearity the relationships between the predictor variables should be checked in a correlation matrix with all relevant predictor and the outcome variables. This check of correlation coefficients only checks for bivariate collinearity, to check for higher order collinearity Tolerance and variance Inflation factors were calculated with SPSS.
Appendix  F - Cronbach's alpha and validation of normality assumption (individual level)

<table>
<thead>
<tr>
<th></th>
<th>Cronbach's alpha</th>
<th>Mean</th>
<th>SE</th>
<th>Kurtosis</th>
<th>Skeweness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity beliefs</td>
<td>.571</td>
<td>3.67</td>
<td>.049</td>
<td>-.599</td>
<td>.133</td>
</tr>
<tr>
<td>Behavioural integration (t_1)</td>
<td>.68</td>
<td>3.74</td>
<td>.057</td>
<td>.433</td>
<td>.218</td>
</tr>
<tr>
<td>Behavioural interdependence (t_2)</td>
<td>.698</td>
<td>3.74</td>
<td>.064</td>
<td>-.010</td>
<td>-.500</td>
</tr>
<tr>
<td>Information elaboration (t_1)</td>
<td>.81</td>
<td>3.62</td>
<td>.057</td>
<td>.539</td>
<td>.218</td>
</tr>
<tr>
<td>Information elaboration (t_2)</td>
<td>.843</td>
<td>3.72</td>
<td>.058</td>
<td>1.07</td>
<td>-.677</td>
</tr>
<tr>
<td>Team psychological safety (t_1)</td>
<td>.517</td>
<td>3.75</td>
<td>.047</td>
<td>-.479</td>
<td>-.248</td>
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Total of students sample n= 144
Appendix G - Descriptives and interrater agreement team variables ($r_{wg(j)}$)

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Behavioural integration (Li & Hambrick, 2005); information elaboration (van Dick et al., 2008); team psychological safety (Gibson & Gibbs, 2006); team identification (Earley & Mosakowski). All $r_{wg(j)}$ were calculated with the SPSS syntax proposed by LeBreton et al. (2007) under the assumption of uniform response distribution.
Descriptives and interrater agreement team process variables \( \left( r_{wg(j)}, t_2 \right) \)

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*behavioural integration (Li & Hambrick, 2005); information elaboration (van Dick et al., 2008); team psychological safety (Gibson & Gibbs, 2006); team identification (Earley & Mosakowski); All \( r_{wg(j)} \) were calculated with the SPSS syntax proposed by LeBreton et al. (2007) under the assumption of uniform response distribution*