SELF-ORGANIZING, SOCIAL AND ADAPTIVE NATURE OF AGILE INFORMATION SYSTEMS DEVELOPMENT TEAMS: ESSAYS ON LEADERSHIP AND LEARNING

I n a u g u r a l d i s s e r t a t i o n

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عشق آموخت مرا شکل دگر خندیدن ...

Rumi: دیوان شمس-مولوی

"Someday, after mastering the winds, the waves, the tides and gravity, we shall harness for God the energies of love, and then, for a second time in the history of the world, man will have discovered fire."

Pierre Teilhard de Chardin

ACKNOWLEDGEMENTS

"Yesterday I was clever so I wanted to change the world; today I am wise, so I am changing myself." *Zahid Iqbal Khan*

Before I began, I was told that the PhD journey would be a tough one. I was not able to fully realize this until I started my PhD studies. I should therefore express my gratitude to those who made it possible for me to walk, learn, enjoy and grow on the path.

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The collective support and love made me who I am now: a better and more conscious person to celebrate life.

Namaste,

To my mom & dad,

And to

Afsaneh Tarfiei who is a blessing in my life

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Chapter 1

INTRODUCTION

1 Introduction

1.1 Justification

Information Systems Development (ISD) keeps changing and evolving rapidly in a huge variety of aspects, including the technologies that are developed, the methods that are applied, and the structures in which it is organized (Avison & Fitzgerald, 2006). With agile principles integrated into ISD practices in many companies, the emphasis today is more than ever on the team as a source of creativity and software quality (Dybå & Dingsøyr, 2008). Consequently, not only the individual team members must keep pace with frequent changes, but also must the team as a whole. In order to learn and develop innovative solutions and adaptive outcomes, all team members' skills and expertise should be leveraged and brought to bear at the team level. ISD teams which actively learn about technologies, customer activities, and group processes on a team level can, therefore, develop better software and increase their performance (Janz & Prasarnphanich, 2003, 2009).

Furthermore, organizations are facing complex competitive environments driven largely by globalization and technology (Sambamurthy, Bharadwaj, & Grover, 2003). Therefore, there is no doubt for any organization regarding the importance of organizational ability to identify and manage and respond to change (By, 2005). Likewise, in the software industry there is an increasing demand to deliver high quality software more efficiently (McAvoy, Nagle, & Sammon, 2013). In order to handle the unstable, unpredictable user requirements and respond quickly to changing environments, agile Information Systems Development (ISD) approaches have been widely applied in ISD processes (Highsmith, 2002; G. Lee & Xia, 2010), and are progressively seen as a valid solution (Pelrine, 2011). Agile ISD emphasizes self-organizing teams and empowered individuals in order to more effectively produce software (Highsmith, 2010). Agile ISD teams are essential social networks that interact intensively (Boehm & Turner, 2004). Agile ISD puts a stronger emphasis on people who require a higher degree of human communication and social interactions (Vidgen & Wang, 2009).

On the other hand, leadership is of crucial importance to the sustainable success of organizations (Smith & Lewis, 2011). Over the years, researchers have investigated the influence of leadership on effectiveness including such adaptive outcomes as learning

and innovation (Clarke, 2013; Edmondson, Dillon, & Roloff, 2007; Uhl-Bien, Marion, & McKelvey, 2007), and performance (Drescher, Korsgaard, Welpe, Picot, & Wigand, 2014; Mathieu, Maynard, Rapp, & Gilson, 2008; Zaccaro, Rittman, & Marks, 2002). Accordingly, leadership is increasingly recognized by organizations as an important hallmark of business growth and consequently has led to large investments in leadership development (Bilhuber Galli & Müller-Stewens, 2012). Moreover, the impact of leadership on adaptive outcomes of teams, such as innovation and learning, has been long studied by researchers (Edmondson et al., 2007). Whereas research has traditionally focused on the human capital of individuals (knowledge, skills, and abilities) for adaptive outcomes, recent research has turned to the social aspects of adaptive outcomes (e.g., Amabile, 2012; Fleming et al., 2007; Zhou et al., 2009). These researchers have argued that the creation of diverse and non-redundant ideas requires a focus on the social networks or social capital of individuals (Han et al., 2014).

Consistent with the changes in the business environment, the field of leadership studies is also evolving. Leadership is no longer simply described as an individual characteristic or style (Avolio, Walumbwa, & Weber, 2009), but rather is an emergent, interactive dynamic (Lichtenstein & Plowman, 2009) which focuses on a process that inherently involves multiple individuals (e.g., among peers in a self-organizing team) (Day, Fleenor, Atwater, Sturm, & McKee, 2014). Leadership is now a "social capital that collects around certain individuals" (Balkundi & Kilduff, 2006, p. 421). For leadership researchers, social capital has been regarded as one of the key factors of leadership development (Day, 2000).

In the software industry, agile methods explicitly integrate behavioral and social concerns into ISD (Whitworth & Biddle, 2007). Placing focus on human and social factors is important for the success of an agile initiative (Dybå & Dingsøyr, 2008). Although the term leadership does not occur in any value or principle of agile ISD teams (Fowler & Highsmith, 2001), there are some indicators that shape the ground of leadership discussion in agile ISD teams (Moe, Dingsyr, & Kvangardsnes, 2009). Agile ISD teams are self-organizing and empowered, but not leaderless or completely uncontrolled (Cockburn & Highsmith, 2001).

Over recent years, scholars have tried to elaborate on the differences between management and leadership (McAvoy & Butler, 2009; Vidgen & Wang, 2009; Yang, Huff, & Strode, 2009; Moe, Dingsyr, et al., 2009), and also on the different roles (Hoda, Noble, & Marshall, 2013) in agile ISD teams. Generally, researchers have shed light on the adaptive nature of leadership in ISD teams (e.g., Augustine et al., 2005; Highsmith, 2010).

However, agile ISD platforms such as scrum have been criticized by practitioners for not being a platform for adaptive outcomes (Cohn, 2014; Serrador, 2014). Therefore, considering the complex social and adaptive nature of agile ISD teams, the importance of leadership, and paradoxical outcomes of efficiency and adaptivity in agile ISD teams, there are several reasons why an in-depth study of adaptive outcomes and leadership and social capital development in agile ISD is believed to make major contributions:

First, agile ISD teams, as social dynamic networks, are not free from management control (Cockburn & Highsmith, 2001), and this creates a common misconception about little or no role for leaders in agile ISD teams (Cohn, 2010). The important role of management in agile teams is mainly ignored (Appelo, 2011) and to the best of our knowledge there is little empirical support on the topic. Second, as aforementioned, leadership is now conceptualized beyond an individual-level skill (Day, 2000); rather it is described as a shared, relational, and social dynamic (Avolio et al., 2009; Yukl, 2012). The few studies on leadership in agile ISD mainly focus on the role of leader rather than on the process of leadership. Agile ISD teams are not limited to developers; there are many different stakeholders that interact with these teams. As a result, there is a need to further study these teams in a broader and deeper scope (e.g. a dynamic network). Third, scholars need to consider how leadership processes change and evolve as they are influenced by context (Dinh et al., 2014; Hazy & Uhl-Bien, 2013b). Forth, agile ISD teams are dynamic social networks, and to study adaptive outcomes in these teams the social network of people should be considered. However, as mentioned, studies on adaptive outcomes in teams focus mainly on human capital and less on social capital. Fifth, as Obstfeld (2005) argues, although bridging social capital may lead to creative ideas, it is the bonding social capital of connected groups that provides the ease of coordination necessary to implement innovative ideas and adaptive outcomes in organizations. Studying how agile ISD teams bridge and bond social resources seems es-

sential for understanding paradoxical concepts of adaptivity and efficiency in agile ISD teams. Thus, the social nature of agile ISD teams creates a proper context to study adaptive outcomes and learning, leadership and social capital.

1.2 Structure of the Dissertation

Noticing the need for further understanding of adaptive outcomes such as learning and leadership in agile ISD teams, I divided my research plan into different phases. My field research took place in a software company between June 2011 and August 2014. The first phase was the review of the literature on learning in the Information Systems (IS) literature within IS development teams. Findings from the systematic literature review are reported in Paper 1, entitled "Team Learning in Information Systems Development: A Literature Review". The second phase includes the process of exploring the research field, and initiating the research problem. The research design, initial theoretical foundation and initial data analysis results of the first phase case study are reported in a published conference paper (Gholami & Heinzl, 2013), and a published workshop paper (Gholami, 2013). In addition, the initial research design for the last phase was selected and presented as a research proposal in the Doctoral Consortium of 21st European Conference on Information Systems (2013). The last phase includes a comprehensive case study through which Paper 2, entitled "Self-Organization and Leadership in Agile Teams: A Complexity Leadership Approach", and Paper 3, entitled "Social Capital and Adaptive Outcomes in Agile Information Systems Development Teams", are derived.

The remainder of this dissertation is as follows: first, I provide an overview of the three included research papers as well as related but excluded papers, and explain the link among them. Second, I present the content of the three included research papers. Depending on the target outlet, the presentation, referencing and wording are different in each paper. I conclude this dissertation with a summary of the research findings and contributions of the three papers. I attach the semi-structured interview protocol to this dissertation in Appendix A, the list of my publications in Appendix B, and the list of related seminar papers and theses that I supervised in Appendix C.

2 Overview of the Cumulative Manuscripts

2.1 Team Learning in Information Systems Research

To gain an overview of the state-of-the-art research on team learning and adaptivity, I, together with colleagues, conducted a systematic literature review in Paper 1.

In Paper 1, we addressed:

- *Why and how do Information Systems Development (ISD) teams (not) learn?*
- *What are the consequences for future research on ISD management and methodologies?*
- *Scholarly critique of theory (Schwarz, Mehta, Johnson, & Chin, 2007; Webster & Watson, 2002)*

For team learning, we used the working definition of Wilson, Goodman, & Cronin (2007) as "change in the work group's repertoire of potential behaviors". We conducted a structured review (Kitchenham et al., 2009; Okoli & Schabram, 2010), and searched for terms: learn*, knowledge management, and transactive memory in top outlets of IS and neighboring disciplines, e.g., AIS senior scholars' basket of journals, IEEE Transactions on Engineering Management and Software Engineering Management Science, Decision Sciences, Organization Science.

Based on the qualitative data analysis (Okoli & Schabram, 2010), we drew on and extended Edmondson et al. (2007)'s classification scheme of team learning literature. In general, the findings revealed four types of team learning definitions and conceptualizations:

- Team learning curve: "Rather than explaining properties of team learning, research in this realm has aimed at finding determinants of team performance improvements" (Spohrer, Gholami, & Heinzl, 2012).
- Shared knowledge and group memory: Team learning is defined as a step toward task mastery and is indicated in changes in the teams' state of common knowledge or meta-knowledge (Spohrer et al., 2012).
- Team learning behavior as a group process: Team learning is an ongoing group process of reflection and action (Edmondson et al., 2007).

- New structural approach: Team learning consists of interactions between networked actors (Spohrer et al., 2012). In this approach some individuals can become more important than others for overall team learning. Theories that are used by researchers account for both individual and group levels, central actors in the learning network are often found in senior positions, and the flow of knowledge between single team members is not necessarily reciprocal (Spohrer et al., 2012).

Moreover, comparing IS research with that of other related disciplines, the findings revealed that the constructs of team leader, team goal and task characteristics are largely missing in IS research concerning team adaptivity and learning. The findings from Paper 1 led me to shed more light on the new structural approach and scrutinize the missing constructs in IS research.

2.2 Leadership and Complex Adaptive Systems (CAS)

Exploring a multinational software company in which agile Information Systems Development (ISD) methodologies had been implemented since year 2009 provided me with a unique context for ethnographic field research. Talking with many team members and managers and observing teams' daily work and discussions, as well as having access to the company's surveys, corporate portal and internal wikis directed me to concentrate on the "role of leaders" and "process of leadership" in agile ISD teams.

On the other hand, the complex interactions and interrelations among agile ISD team members, managers and customers led me to consider the team not as a single and simple unit of analysis, but as an adaptive system. Moreover, I observed that there are many different roles in an agile ISD team and there are still conflictions and misunderstandings in the company relating to the concept of managers and leaders in the agile ISD teams, as self-organizing teams.

I then conducted a case study including three agile ISD teams. I conducted 24 interviews to find out "In which areas can leaders in agile ISD teams influence collective learning?" The findings of the study were presented at the Organizational Learning, Knowledge and Capabilities Conference (2013). The findings show that in the studied

agile ISD teams leadership, team empowerment, team learning goal, and task characteristics mainly affect team learning (Gholami & Heinzl, 2013).

To examine leadership and learning in agile ISD teams, I first paid close attention to the nature of agile ISD teams. Being agile and adaptive (Highsmith, 2010; G. Lee & Xia, 2010; Meso & Jain, 2006), and self-organizing (Hoda et al., 2013; Vidgen & Wang, 2009) are among the major attributes of agile ISD teams. Agile ISD teams are, in fact, Complex Adaptive Systems (CAS) (Highsmith, 2010, 2010; Kautz, 2012; Meso & Jain, 2006; Vidgen & Wang, 2009). CAS consist of feedback loops, and learning which arises from interaction of these loops with one another (Sterman, 2000). CAS react effectively to the changing environment and bring the system to equilibrium during times of tension (Lichtenstein & Plowman, 2009). To address the CAS theory approach in leadership, Uhl-Bien et al. (2007) have proposed Complexity Leadership Theory (CLT). I generally focused on uncertain situations and times of decision making. During these times, agile ISD teams, such as CAS, are supposed to show adaptability and agility. Figure 1 illustrates the conceptual framework of Paper 2. In this paper, agile ISD is the context of the study where teams are self-organizing and empowered, and designed to respond to changes. I shed light mainly on self-organization patterns during situational changes, and on roles, relationships and mechanisms, which influenced teams to unravel situational factors. I then addressed whether any kind of adaptive outcome is the product of effectively unraveling situations.

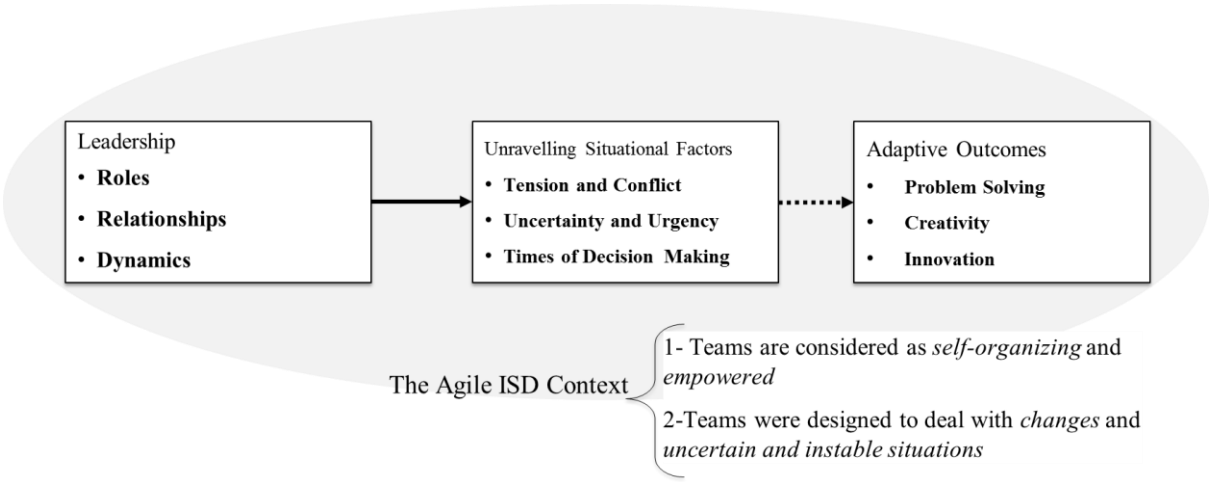

Figure 1. Conceptual framework of Paper 2

Therefore, in Paper 2, I used CLT to:

- *Explore self-organization and leadership in the complex and dynamic context of agile ISD teams.*
- *Understand how adaptive outcomes (e.g., learning and innovation) are facilitated during tensions and uncertain situations.*

I adopted an embedded case study approach with an interpretive stance. The interview phase took place in the period between June 2014 and August 2014. Initially I collected data from 28 agile ISD teams located in five countries. I interviewed 88 individuals. Interviews led to several hundred pages of transcriptions. However, I analyzed the data from 12 teams and 34 individuals due to time restriction for my dissertation. Table 1 shows the original data collection.

Table 1. Original data collection

Location	**# Dev. Teams**	**Area Product Owner**	**Line Manager***	**Product Owner**	**Scrum Master**	**Developer**	**Total # Interviews***
Brazil	6	2	1	6	3	1	16
Germany	5	2	2	5	4	1	12
Czech Republic	4	2	-	4	4	1	10
Russia	2	1	-	2	2	1	5
India	8	4	1	8	4	2	20
China	3	2	-	3	3	1	8
Total (Dev.)	28	13	-	28	20	8	71
The core team	-	-	-	-	-	-	17
*To be finalized							**Total: 88**
**Some of team members had more than one role							

I generally use the term "adaptive outcomes" as proposed by Uhl-Bien et al. (2007) to address learning in the studied agile ISD teams. I elaborated on the concepts in both Paper 2 and Paper 3.

Through cross-case analysis for Paper 2, I was able to categorize the teams into two general groups: "adaptive" and "non-adaptive". "Adaptive" teams are those in which there was at least one situation where a new idea or suggestion was recognized by the team, and made its way to implementation. I categorized an agile ISD team in the

"adaptive" category depending on whether at least one of the interviewees on the same team was able to tell me about the "creativity" story. My categorization "non-adaptive" included those teams in which all the interviewees claimed not to remember any time that they come across or were allowed creativity.

To the best of my knowledge, this study is one of the few studies that address complexity leadership in teams as the unit of analysis. The empirical studies on the topic mainly target individuals as the unit of analysis.

The findings unfold patterns of self-organization in agile teams, which I call *Diffusion* and *Osmosis*. Furthermore, the findings question the "adaptive leadership" element in CLT, since I did not observe "adaptive outcomes" when the teams tried to self-organize themselves during different situational tensions. The findings contribute to this question of whether CAS as self-organizing systems are adaptive; and whether this adaptability only involves the system adaptability to respond to the change, or whether it involves to adaptive outcomes. This research suggests that to study the outcomes of complexity leadership, the constraints of the context should be taken into account (e.g., agile information systems development). Moreover, this research suggests a list of leadership activities, grounder in CLT, to unravel each particular uncertainty.

2.3 Social Capital and Leadership Development

Subsequently, for Paper 3, I took a deeper look into the behaviors of agile ISD teams during different situations to see if any team pattern would lead to adaptive outcomes. The three-dimensional perspective of social capital (Nahapiet & Ghoshal, 1998) is an appropriate theoretical lens for Paper 3. It encompasses not only the overall patterns of connections (structural) in an agile ISD team, but also the kind of personal relationships developed through a history of interactions (relational) (Granovetter, 1992), as well as the underlying shared representation and collective meaning (cognitive) within a network.

Figure 2 illustrates the conceptual framework of Paper 3. In this paper I mainly focused on patterns and configurations of social capital and in turn leadership development which are formed and leveraged by different situations during the lifetime of an agile ISD team.

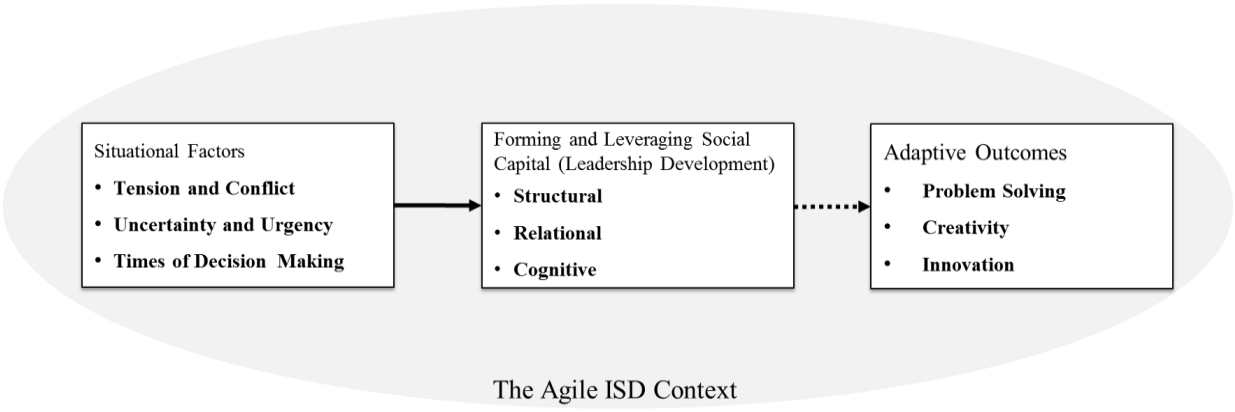

Figure 2. Conceptual framework of Paper 3

Therefore, in Paper 3, I used social capital theory to understand:

- *How social capital develops in agile ISD teams*
- *How social capital development leads to adaptive outcomes in agile ISD teams.*

As with Paper 2, this study is also based on the data collected and analyzed from 12 teams and 34 individuals. The dataset used for Paper 2 and Paper 3 is the same; however, each paper is based on a different theoretical lens and different research questions. Considering the social nature of agile ISD teams, I also adopted an interpretive case study (Walsham, 1995, 2006) for this research.

The social capital assessment of the studied agile ISD teams revealed two different social capital configurations in terms of task complexity and connectivity and team members homogeneity: *collective* and *island.* These two configurations are structurally, relationally, and cognitively different from each other. I also found detailed characteristics of each configuration and enablers and inhibitors of adaptive outcomes in both types. Based on inductive data analysis, I furthermore proposed solutions to handle inhibitors of adaptive outcomes.

In sum, Papers 2 and 3 responded to the call in Paper 1 and filled the gap of leadership, team goal and task characteristics using the new structural approach to learning and adaptive outcomes in the IS teams. Figure 3 illustrates an overview of the research studies and related research papers.

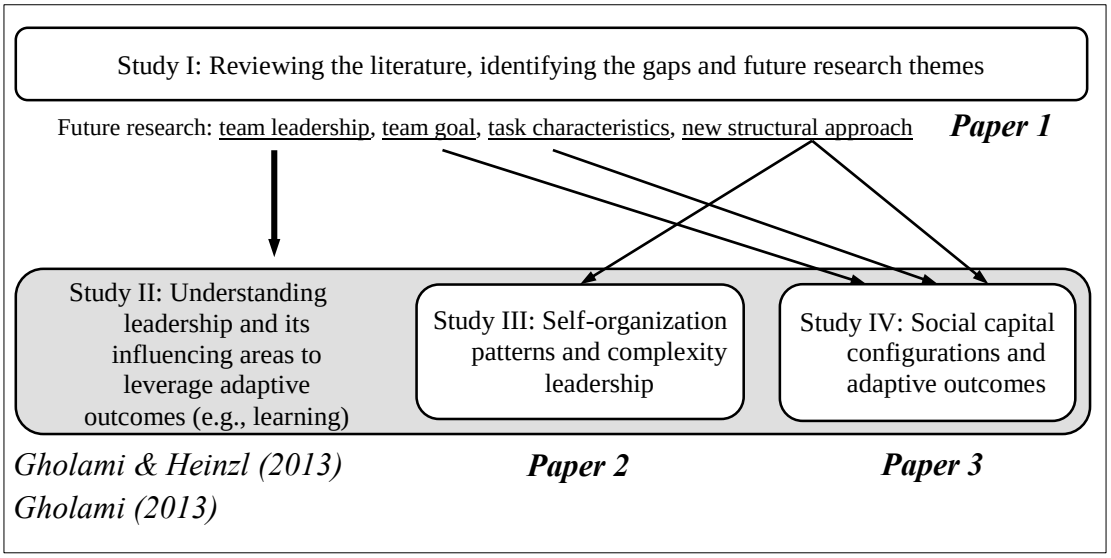

Figure 3. Overview of research studies and related research papers

Chapter 2

TEAM LEARNING IN INFORMATION SYSTEMS DEVELOPMENT: A LITERATURE REVIEW

Spohrer, Kai; Gholami, Behnaz; and Heinzl, Armin, "Team Learning in Information Systems Development – A Literature Review" (2012). *ECIS 2012 Proceedings.* Paper 223.

This paper has been submitted to, and presented in 20th European Conference on Information Systems 2012, Barcelona, Spain

Abstract . *Information Systems Development (ISD) is fast moving, knowledge-intensive and requires a substantive amount of teamwork. In order to develop quality software, teams need to leverage the skills and knowledge of each team member. ISD teams who engage in learning at a group level can perform more effectively and efficiently. However, relative to other disciplines, knowledge and literature about team learning in ISD research is new and dispersed. This fact hampers the cumulative progress in research that seeks to answer questions about how ISD teams learn to work together and improve their performance. We draw on and extend the classification scheme of Edmondson et al. (2007) and conduct a review of ISD team learning research literature. We synthesize the main findings and highlight the limitations of existing approaches. We emphasize potential directions for future research while focusing on the resulting implications for ISD management and methodology. We further demonstrate that there are four distinctive streams in ISD team learning research that differ in the manner that they conceptualize team learning, underlying theories, and research methodologies. Finally, we illustrate how these differing streams can cross-fertilize and thereby present notable aspects of team learning presently addressed by related disciplines for which there is scant or non-existent ISD research.*

Keywords: *Team learning, Information Systems Development (ISD), Transactive memory system, Development methodology.*

1 Introduction

Information Systems Development (ISD) keeps changing and evolving rapidly in a huge variety of aspects, including the technologies which are developed, the methods that are applied, and the structures in which it is organized (Avison & Fitzgerald, 2006). With agile principles integrated into ISD practices in many companies, the emphasis today is more than ever on the team as a source of creativity and software quality (Dybå & Dingsøyr, 2008). Consequently, not only the individual team members must keep pace with frequent changes, but so must the team as a whole. In order to develop innovative solutions, all team members' skills and expertise must be leveraged and brought to bear at the team level. ISD teams who actively learn about technologies, customer activities, and group processes on a team level can, therefore, develop better software and increase their performance (Janz & Prasarnphanich, 2003, 2009). While other disciplines have made attempts to organize their body of knowledge on team learning (e.g. Edmondson et al. 2007; Wilson et al. 2007; Goodman and Dabbish 2011), team learning research in ISD has been dispersed and unorganized thus far. Scholars have accentuated the need for team learning theories that take the specifics of disparate tasks and industry domains into account (Edmondson et al. 2007), but without a consolidated body of research this is hardly possible for ISD. In this paper, we capture, therefore, the current state of research on team learning in ISD in order to foster cumulative scientific progress in our discipline. We concentrate on the following questions: why and how do ISD teams learn; and what are the consequences for future research on ISD management and methodologies. Drawing on and extending Edmondson et al. (2007)'s classification scheme of team learning literature, we critically synthesize substantive findings and reveal limitations that are present in the current streams of ISD team learning literature with regard to conceptualizations, research methodology, logic, and hidden assumptions. Moreover, we contrast research in ISD team learning with current team learning literature from neighboring disciplines. We depict concepts that are frequently investigated in those disciplines but have remained nearly unattended in our field. Finally, we highlight implications for research on ISD management and methodologies and thereby provide fruitful directions for future research in our discipline to understand ISD team learning and its outcomes.

2 Research Methodology

We conducted a systematic review of ISD literature to consolidate the present body of scholarly ISD research on team learning and explore how ISD can benefit from team learning research by related disciplines. We followed a systematic approach as proposed by different scholars (Kitchenham et al., 2009; Kitchenham & Charters, 2007; Okoli & Schabram, 2010) to create a proper synthesis and scholarly critique of theory (Okoli & Schabram, 2010; Schwarz et al., 2007; Webster & Watson, 2002). Having defined our research questions, we developed a review protocol. This protocol consisted of: (1) defined research sources; (2) means of access to be used; and (3) basic inclusion and exclusion criteria (Kitchenham & Charters, 2007). As a working definition, we conceptualized team learning as any change in the work group's repertoire of potential behaviors (Wilson et al. 2007), and included papers that addressed antecedents, effects or properties of such change. We excluded educational and technology-focused literature as we wanted to understand the social phenomenon of learning in ISD teams rather than education in classrooms or technological aspects of ISs. In order to restrict the sample of papers to rigorous research, we included only top quality outlets from IS and related disciplines. The list of sources searched included, among others, the AIS senior scholars' basket of journals, IEEE Transactions on Engineering Management and Software Engineering, Management Science, Decision Sciences, Organization Science and top IS conference proceedings. We searched the selected IS outlets in the database Social Sciences Citation Index via the Web of Science, IEEE Xplore, and the AIS Electronic Library for the search term "*learn**". In addition to IS journals, we searched a set of high impact journals from the related disciplines of management and organization science. Since we could build on several rigorous reviews in these disciplines (Edmondson et al., 2007; Goodman & Dabbish, 2011; Wilson et al., 2007), we focused on recent papers of these disciplines published after 2006. We did not impose such a restriction on IS papers. In order to ensure consistency throughout the literature selection process, the first and the second authors of this paper engaged in the selection procedure (Okoli & Schabram, 2010) by: (1) jointly conducting an examination of the first 25 papers; (2) discussing any different opinions about whether or not to include any one of these papers; (3) dividing further selection activities between them; and (4) then consulting one another regarding selections only in ambiguous cases. In order to address the critique of systematic literature reviews (Boell

& Cezec-Kecmanovic, 2010), we also reviewed the selected papers to determine whether any of them referenced research papers that we had inadvertently overlooked in our initial selection process. We realized that some relevant and referenced papers had not been retrieved by our first queries. Consequently, we performed an additional iteration of search and selection for the terms "*knowledge management*" and "*transactive memory*" which helped to include these papers. In total, our queries in titles, abstracts, and keywords returned more than 600 hits. Based on the titles and abstracts, we excluded all contributions that clearly did not address learning on a team level or that focused on the examination of knowledge management information systems without also addressing aspects of our defined research questions. 86 papers were selected for closer examination and 60 of these were found to address learning on a team level. We read the latter and extracted data about their findings, key concepts, methodology, and key aspects regarding conceptualizations of team learning, and of ISD if present. At least two authors validated the extracted data for every paper. Finally, we synthesized collectively the 24 studies that addressed ISD team learning, along with the key concepts and emerging patterns they described (Schwarz et al., 2007; Webster & Watson, 2002), and contrasted them to the research from related disciplines. These results are presented below.

3 Team Learning in Information Systems Development

Learning on a team level has long been recognized as a decisive factor influencing the performance of all work groups (Edmondson et al., 2007). However, there is a variety of definitions of team learning. These conceptualizations of team learning can, therefore, be a useful criterion to understand the logic and hidden assumptions that underlie different streams of research on this topic. Edmondson et al. (2007) differentiate between three conceptualizations prevalent in literature and find that, according to the selected conceptualization, studies differ in their main dependent and independent variables, methods, and findings. In the following, we show that these streams also exist in ISD team learning research. We discuss their assumptions, methods, findings, theories, and potentially fruitful future directions. Moreover, we identify a fourth, recently emerged stream that differs from the others in its underlying concept of team learning and takes a more structural perspective.

3.1 The Team Learning Curve of Outcome Improvement in ISD

Research on performance improvement is traditionally conducted with an emphasis on learning curves (Argote, Beckman, & Epple, 1990), without any deeper investigation into the underlying mechanisms of team learning at a group level. Accordingly, the concept of team learning is one of mere outcome improvement (Edmondson et al. 2007). Rather than explaining properties of team learning, research in this realm has aimed at finding determinants of team performance improvements. Based on observed improvements in productivity and logical reasoning, research has assumed team learning to occur, without the empirical proof of direct measurements (Edmondson et al., 2007). For example, Teasley et al. (2002) reason that the performance increase they observe in settings of radically collocated ISD teams is largely caused by better opportunities for team learning. Whether and how such learning takes place, however, exceeds the boundaries of this school of research.

Based on analytical models and a case study, Mookerjee and Chiang (2002) show that tighter coordination policies are more appropriate for ISD teams which are early on the learning curve from a total effort perspective than they are for more advanced teams. Following the same school of thought, Boh et al. (2007) define learning as "the increase in productivity of developers as their experience increases" (Boh et al., 2007, p. 1322). Accordingly, different types of experience are frequently examined and related to the development of team performance. For example, the experience of developers and project managers in their respective roles within their ISD teams demonstrates a much stronger effect on team performance than does their mere respective experience within the company (Huckman, Staats, & Upton, 2009). In accordance with this finding, experience with the applied software development methodology is emphasized as outstandingly decisive for team performance, while the knowledge gained from such experience is, interestingly, also being forgotten more rapidly than application or domain knowledge (Kang & Hahn, 2009). Similarly, team productivity is found to be higher if ISD team members possess diverse experience with related tasks than if they are experienced in more unrelated systems or specialized in a single task (Boh et al., 2007). In general, higher familiarity by team members also appears beneficial for ISD team performance, and improved learning is frequently argued to be due to such familiarity (Boh et al., 2007; Huckman et al., 2009).

Despite its achievements, learning curve research on ISD team performance does not provide a conclusive answer to why such learning occurs or which mechanisms produce this complex interplay of experience and performance. Accordingly, there is an absence of theories in this stream of research that might explain such relationships. Only a minority of studies offer hints at concepts that might be useful for explaining these relationships (Teasley et al., 2002). Regarding research methodology, learning curve research in ISD builds on mostly quantitative analyses of archival data (Boh et al., 2007; Huckman et al., 2009; Kang & Hahn, 2009; Teasley et al., 2002), selectively combined and enriched with other instruments like analytical models (Mookerjee & Chiang, 2002) or qualitative follow-up interviews (Teasley et al., 2002).

3.2 Shared Knowledge and Group Memory in ISD

A second stream of literature conceptualizes team learning as a step towards task mastery and typically tries to explain learning effects as the "outcome of communication and coordination that builds shared knowledge by team members about their team, task, resources, and context" (Edmondson et al., 2007, p. 277). The underlying assumption of this research is that commonly shared knowledge and meta-knowledge indicate that: (a) learning occurs at the team level; and (b) this common ground is explicitly and implicitly used by teams to improve their performance. It is thereby acknowledged that teams consist of individuals among whom knowledge is unevenly distributed and that the dissemination of individual knowledge into the group is central to realizing performance gains. Nevertheless, shared knowledge and group memory research conceptualizes team learning as the result of activities like the dissemination of knowledge rather than the activities themselves (Edmondson et al., 2007; Goodman & Dabbish, 2011; Wilson et al., 2007). Socio-cognitive memory structures indicate teams learn from individual experiences. Different structures of group memory have been proposed in order to grasp this concept. The most pronounced one is Wegner (1987)'s Transactive Memory System (TMS). Such group memory structures connect single team members, who possess specialized knowledge, over the shared meta-knowledge of how certain task characteristics match the single individuals' resources (Alavi & Leidner, 2001; Wegner, 1987). In other words, team members use each other as a memory source (Oshri, van Fenema, & Kotlarsky, 2008). TMSs constituting an antecedent of team performance have especially been frequently

examined on a team level in IS and organizational research (Choi, Lee, & Yoo, 2010; Edmondson et al., 2007).

One central finding of this stream of research is that knowledge and meta-knowledge shared in group memory account for the performance of ISD teams in several dimensions. Scholars find that knowledge shared in group memory improves ISD teams' effectiveness and efficiency, and enhances their ability to transfer knowledge to others, as well as their ability to integrate external knowledge creatively into software products (Espinosa, Slaughter, Kraut, & Herbsleb, 2007; Samer Faraj & Sproull, 2000; He, Butler, & King, 2007; Kotlarsky & Oshri, 2005; Maruping, Zhang, & Venkatesh, 2009; Nemanich, Keller, Vera, & Chin, 2010; Oshri et al., 2008, 2008; Zhang, Venkatesh, & Brown, 2011). In accordance with the demands of Alavi and Leidner (2001) for more research into the facilitating conditions of learning and knowledge management, several research endeavors have been undertaken to find the antecedents for the establishment of group memory structures in ISD teams. Unsurprisingly, scholars find close and frequent interactions of team members to be one of these antecedents (He et al., 2007; Levesque, Wilson, & Wholey, 2001). However, such close interactions are much harder to achieve in globally distributed software development teams whose members must potentially work across spatial, temporal, and socio-cultural boundaries. This distribution can heavily impact the teams' abilities to create a group memory system suiting their needs (Espinosa et al., 2007; He et al., 2007; Oshri et al., 2008). While the negative influence of team distribution can be reduced by employing coordination mechanisms of a wide range, from mutual visits over standardized organizational structures to communication technologies, these must be finely tuned as the situational settings influence the mechanisms' applicability (He et al., 2007; Oshri et al., 2008).

Group memory systems in ISD evolve over time and can grow or shrink (He et al., 2007). One reason is that ISD team members differ in their needs for interaction depending on their roles and tasks. For example, developers perceive different pressure points in team coordination than do ISD managers (Espinosa et al., 2007). Consequently, ISD teams whose members increasingly specialize in a certain role and work on tasks having low interdependency with others tend to have shrinking group memory over time (Levesque et al., 2001). In line with this argument, Vidgen and

Wang (2009) propose that more interconnecting practices, multi-skill development, and autonomy in ISD can enhance team learning. However, recent findings by Nemanich et al. (2010) indicate that there are more complex relationships between team knowledge, autonomy, individual developers' capabilities, and teams' ability to learn, than previously assumed. Interestingly, these authors find that possession of existing knowledge does not necessarily improve ISD teams' ability to learn. Quite the contrary, they find that teams with less prior knowledge are forced to learn more rapidly and receive more benefits from doing so (Nemanich et al., 2010). Moreover, mechanisms to control the importance of large bodies of shared knowledge in ISD teams also appear to exist. Maruping et al. (2009), for example, find that collective code ownership reduces the impact of the group memory system on the quality of software development, while established coding standards increase it. Finally, the establishment of a group memory system can also be fostered by appropriate knowledge management systems (Zhang et al., 2011).

Two theoretical lenses underlie the majority of studies on group memory in ISD research: (1) shared cognition based on the concept of shared mental models (Cannon-Bowers, Salas, & Converse, 1993); and (2) TMS (Wegner, 1987). Only Vidgen and Wang (2009) and Zhang et al. (2011) ground their work in other theories, namely absorptive capacity and complex adaptive systems. From a methodological perspective, two research designs are applied: (1) survey-based quantitative analyses (Samer Faraj & Sproull, 2000; He et al., 2007; Levesque et al., 2001; Maruping et al., 2009; Nemanich et al., 2010; Zhang et al., 2011); and (2) qualitative, interview-based case studies (Espinosa et al., 2007; Kotlarsky & Oshri, 2005; Oshri et al., 2008; Vidgen & Wang, 2009). While several of these studies acknowledge that there are processes at the team level that are decisive for the development and use of commonly shared knowledge and meta-knowledge, such processes are not captured in any of these studies. In general, this stream of research measures the teams' state of common knowledge or meta-knowledge, but it does not address the actual activities which lead to changes in such knowledge.

3.3 Team Learning Behavior as a Group Process in ISD

While research on group memory merely acknowledges the existence and importance of team level processes and activities without addressing the same, a behavioral school of

team learning research exists which focuses exactly on these aspects. Scholars in this stream of research conceptualize team learning as an ongoing group process of reflection and action (Edmondson 1999), typically including different activities such as information sharing and reflection on expertise (Edmondson et al., 2007). The focus of this stream of research is on teams' learning behaviors from both a theoretical and methodological perspective.

Team learning scholars have highlighted that, not only is the team knowledge important for team performance, but so is what team members actually do with this knowledge. For example, Walz et al. (1993) find that software design team members engage in the acquisition, the sharing, and the integration of knowledge into the group. While an overall increase in the level of domain knowledge at a team level might be helpful, the authors also argue that managed conflict within the team stimulates the team's learning behaviors (Walz et al., 1993). Liang et al. (2003) refine this proposition by demonstrating that the quality of developed software actually increases when team conflict that may be attributable to team members' differing backgrounds and expertise exists during a task. Such task conflict does not necessarily harm the productive communication within the team, but it stimulates learning behaviors. Notwithstanding, evidence also exists that simply teaming developers with different backgrounds and expertise alone does not necessarily lead to more engagement in learning behaviors or more creative results (Tiwana & Mclean, 2005). Further research might be needed to clarify under what conditions ISD teams can benefit from heterogeneous expertise and task conflict in order to improve team performance. Such conflict about how to complete a task requires spare resources for discussions and conflict resolution. Consequently, the relationship between task conflict and team performance is evidently ambiguous. In contrast, other scholars acknowledge that such learning activities might have a positive influence on the team's performance, but argue that the stronger and more important effect of such learning activities is the resulting increase in individual team members' satisfaction with work (Janz & Prasarnphanich, 2003, 2009). Moreover, focusing on learning behaviors, researchers in this stream provide a possible explanation for the ambiguous findings on ISD team autonomy (Nemanich et al., 2010; Vidgen & Wang, 2009) in group memory research – namely that different types of team autonomy might stimulate different learning behaviors and vary in their importance for the overall level of learning (Janz & Prasarnphanich, 2009; Li, Jiang, & Klein, 2009).

Research on team learning behaviors in ISD is not based on a single dominant theoretical lens. It draws from a variety of theories, such as: collaborative learning theory (Janz & Prasarnphanich, 2003, 2009); information theory (Janz & Prasarnphanich, 2003); and social interdependence theory (Li et al., 2009). Regarding research methodology, this stream heavily builds on quantitative survey-based designs. Yet, as in related disciplines, many scholars exclusively collect research data on an individual level. This can lead to a divergence in the levels of analysis and theory that is, neither always necessary, nor desirable in team learning research (Goodman & Dabbish, 2011).

3.4 A New Structural Approach to Analyze Team Learning in ISD

Research in team learning behaviors theoretically and empirically examines learning behaviors as a group process, in the sense of uniform activities like reflection and discussion at a team level. More recently, scholars have adopted the perspective that the individual's role within ISD team learning is more multifaceted than has hitherto been acknowledged (Sarker, Sarker, Kirkeby, & Chakraborty, 2011; Skerlavaj, Dimovski, & Desouza, 2010). They conceptualize the team as a network of individuals who interact in different ways and intensities. Team learning consequently consists of interactions between these networked actors in this perspective. To examine these interactions more closely, researchers choose methods and theories that account for both the individual and the team level in their analyses.

For different reasons, some individuals can become more important for overall team learning than others. For example, Sarker et al. (2011) show that there can be "stars" in globally distributed ISD teams who comprise the central institutions for knowledge exchange activities between team members. These stars are highly trusted by the rest of the team and communicate more frequently with more team members. As a result, they can also serve as boundary spanners for different sub-groups within the team. Interestingly, the stars' own knowledge of technologies or management is not necessarily high (Sarker et al., 2011). Nevertheless, Skerlavaj et al. (2010) show that such central actors in the learning network are often found in senior positions and that the flow of knowledge between single team members is not necessarily reciprocal. Consequently, team members who share more knowledge do not necessarily profit from knowledge returned at an individual level. This might be one possible explanation why

research in ISD team learning behaviors as a group process has produced inconsistent findings about the effects of team level engagement in teaching and assistance to team members (Janz & Prasarnphanich, 2003, 2009; Li et al., 2009).

Skerlavaj et al. (2010) and Sarker et al. (2011) follow an innovative approach in researching team learning in ISD by accounting for the structural and relational properties of the ISD teams as groups of interlinked individuals. In accordance with this perspective, they apply Social Network Analysis (SNA) (Wellman et al., 2003) as a central method in their studies of ISD teams. Regarding underlying theories, the scholars draw from a variety of different perspectives to explain the observed phenomena. Despite the low number of studies taking this structural view to date, we argue that these papers represent a new stream of research in ISD team learning. The reason is that they propose a radically new structural conceptualization of the learning team as a network of individuals whose interactions constitute team learning in their entirety. Accordingly, they also show methodological innovation by the application of SNA to the field of ISD team learning. Moreover, by explicitly taking a perspective that models a relationship between team learning and the learning of team members, researchers might possibly be able to overcome one of the most criticized aspects of team learning research, namely the confusion of group learning and individual learning in a group (Goodman & Dabbish, 2011). Extending the body of research in this stream appears very promising as it opens up a wide field of explanations for the team level phenomena of learning.

Table 1. ISD team learning studies: data collection and analysis methods (multiple possible)

Methods / Streams in ISD Team Learning	**Total**	**Learning Curve**	**Group Memory**	**Group Process**	**Structural Perspective**
survey-based quantitative			7	5	
interview-based qualitative		1	4	1	
archival data for quantitative		4			
others (simulation, SNA)		1			2
Number of studies included	24	5	11	6	2

Table 1 provides an overview of the studies of ISD team learning we found as well as their methodologies. In summary, we find four streams of research on team learning in ISD based on the three categories proposed by Edmondson et al. (2007): (1) learning curve research which treats learning as a black box between situational factors and outcome improvement; (2) group memory research which takes a knowledge-centered perspective on team learning as the creation of a system of common knowledge and meta-knowledge; (3) team learning behavior research which addresses the distinct team level processes of learning as observable group activities; and finally (4) a structural approach which explicitly accounts for the dynamic learning structures and relations between individuals that constitute team learning in their entirety. These schools all make valuable contributions to a growing body of knowledge and expose distinct features which shed light on equally distinct aspects of team learning in ISD. We consequently agree with Edmondson et al. (2007) that a single, unified concept of team learning is not what scholars should strive to pursue. Instead, we argue for pluralism and cross-fertilization of research streams. Fruitful effects may be created by more theoretical and methodological diversity. Learning behavior research, for example, might profit from analysis of archival data which is common in learning curve research. This could complement existing survey-based approaches to reduce the occasional disparity of the levels of theory and analysis. Similarly, structural approaches might take a larger variety of team learning processes into account to gain a more precise picture of the interactions between individuals and their effects on the team as a collective. Despite all calls for diversity, we also advocate more consistent measures and operationalization across research studies as necessary prerequisites for the cumulative progress of ISD team learning research.

4 Avenues for Future Research

The state of research we have presented so far offers a number of insights into ISD team learning. Comparing the state of this research to literature in related disciplines, it is evident that ISD research has partially or totally ignored some aspects research in related disciplines. Below, we will highlight areas of research where organization and management science research has created a diverse body of knowledge while ISD team learning research has only superficially examined them. Thereafter, we will address the resulting implications for what we perceive as outstanding ISD management and

methodology research given the present state of team learning research in ISD as well as that of related disciplines.

4.1 Contrasting ISD Team Learning to Neighboring Disciplines

Team Leader Behavior: Team leaders often play a dominant role in ISD projects (Nambisan & Wilemon, 2000). Sarin and McDermott (2003) find that a democratic leadership style, initiation of a goal structure by the team leader, and the leader's position within the organization positively relate to team learning. Team leadership also plays a critical role for team effectiveness and team performance (Edmondson et al., 2007; Edmondson & Nembhard, 2009). For instance, team leaders can stimulate team learning by involving the members in the decision-making process and outlining the team goals and expectations (Sarin and McDermott 2003). In line with this argument, Van der Vegt et al. (2010) find that the configuration of power within a team is a key factor important for team learning.

Despite great attention to the role of project managers or team leaders in the success or failure of ISD projects, the link between team leadership and team learning is often missing in ISD team learning research. Among those few researchers who address this link, Vidgen and Wang (2009) note that central task allocation by a project manager without consultation with team members can inhibit learning in ISD. Additionally, Sarker et al. (2011) find formal and emergent leaders to be central for knowledge transfer in globally distributed ISD. Moreover, a change in team leadership style should also influence team learning. A Scrum Master, for instance, is not a traditional team leader. Rather, a Scrum Master's role is that of a facilitator who solves key issues that impede the team's success and takes care of interactions and collaborations (Dybå & Dingsøyr, 2008). One of the most important roles of a Scrum Master is to conduct retrospectives in order to assess lessons learned. The role of a Scrum Master may consequently influence the team's learning very differently from traditional leaders. Therefore, ISD researchers should evaluate and assess different leadership behaviors and roles, as well as their influence on group learning in ISD teams.

Team Learning Goal: Behavior at work and particularly the learning behavior are each affected by different goals and purposes. Tjosvold et al. (2004) propose that team members may reach different conclusions about how their individual goals are

structured, and as a result, adapt their interactions with other team members. Trying to achieve individual goals in a team can conflict with other members' interests. Tjosvold et al. (2004) conclude that goal setting is likely to affect team learning behavior in terms of interactions, information sharing and supporting other members in group challenges. Using goal orientation theory, Hirst et al. (2009) note that "the relationship between an individual's goal orientation and creativity is contingent on team learning behavior" (Hirst et al. 2009, p.282).

Prior ISD research emphasizes that an incongruity of goals, for instance, is often found in distributed teams in offshore ISD projects (Lacity, Iyer, & Rudramuniyaiah, 2008). Team members can have competitive and independent goals that in turn affect team learning. This issue might also be one possible explanation why the influence of knowledge sharing is dependent on the geographical pattern of team member distribution in new product development teams (Staples & Webster, 2008). Research on ISD team learning should clarify to what degree learning goals can beneficially influence team learning and performance in different configurations and team structures.

Task Characteristics: There is empirical evidence of the effects of task characteristics on team learning. Edmondson (1999) outlines several task characteristics that she argues affect team learning. She asserts that "highly routine repetitive tasks with little need for improvement or modification" may inhibit team efficiency and performance (Edmondson, 1999, p. 354). On the other hand, uncertain and risky tasks may raise the need for teams to learn continuously in order to understand the environment, as well as customers' needs. Uncertain tasks may further require team members to coordinate more effectively. Wong (2004) measure task routineness by the frequency of unexpected and novel events that occur during the accomplishment of a task. Research in this direction has created measures and operationalizations of task characteristics in areas related to ISD research, such as new product development (Gino, Argote, Miron-Spektor, & Todorova, 2010). However, only a few ISD team learning scholars (see Huckman et al.(2009)) have attempted to develop such instruments for software development tasks in order to set the characteristics of ISD tasks in relation to team learning and performance. We argue that doing so is a worthwhile endeavor, since: not

all tasks in ISD are non-routine and not all of them demand creativity which might require different levels of team learning for different types of tasks.

4.2 Implications for ISD Management

One of the most prominent fields of research in ISD management is concerned with globally distributed software development projects. An enormous challenge in such a setting is the management of culturally diverse ISD team members. Research is continuously trying to discover and explain effective management practices to address it (Gregory, 2010; Levina & Vaast, 2008). Team learning scholars have contributed to this endeavor by finding mechanisms which stimulate the creation of a common group memory (Kotlarsky and Oshri 2005; Kanawattanachai and Yoo 2007, Oshri et al. 2008). They have also highlighted the existence of different situational prerequisites to and inhibitors of learning activities across the global team, such as trust, psychological safety, and aspects of collocation (Choo, 2011; Staples & Webster, 2008; Van der Vegt, et al., 2010). Notably, team learning scholars have recently argued that globally distributed team members might actually never be able to develop a real shared mental model because of their different backgrounds. Instead, creating cross-understanding is proposed as a better solution (Huber & Lewis, 2010). The implication for global ISD management is that team members should be brought into a position to understand each other's' various values and manner of thinking rather than striving to create one single "negotiated culture" (Gregory, 2010, p. 6). Future research should investigate which underlying team processes can be stimulated in order to create such cross-understanding.

Team learning research also provides an explanation why personnel turnover is an important cost driver in offshore ISD (Dibbern, Winkler, & Heinzl, 2008). When single members leave the team, the existing group memory is negatively impacted, causing a decrease in team performance on occasions when such loss is not successfully accounted for by management (Lewis, Belliveau, Herndon, & Keller, 2007). Since not all individuals are equally central to team learning activities and knowledge flows (Sarker et al., 2011; Skerlavaj et al., 2010), the loss of a single developer can potentially corrupt the entire memory system within an ISD team. As such, future research should investigate how actors who are pivotal to the team's learning activities can be identified

so that timely precautions are taken to address their central role within the team with special care.

4.3 Implications for ISD Methodology

With regard to ISD methodology, team learning research makes several contributions and depicts potential areas for future investigations. First, the findings on team autonomy, which is a central aspect in agile development methods such as extreme programming, are not consistent (Janz & Prasarnphanich, 2003; Nemanich et al., 2010; Vidgen & Wang, 2009). They indicate that different types of team autonomy can stimulate different team behaviors, but not all of them improve performance. Research might address the question of what kind of autonomy should be given to ISD teams in different contexts in order to simultaneously stimulate learning and increase performance. Next, increased development of multiple skills by team members and reduced specialization, which are found in lean software development approaches (Dybå & Dingsøyr, 2008; Poppendieck & Poppendieck, 2003), influence team learning behavior by reducing the need for awareness of expertise location (Maruping et al., 2009; Vidgen & Wang, 2009). However, this does not necessarily lead to higher team creativity or performance as developing similar skills reduces the heterogeneity of expertise and potentially fruitful task conflicts (Janz & Prasarnphanich, 2003; Tiwana & Mclean, 2005). Under certain conditions, hierarchical team structures with specialist roles can actually foster team learning (Bunderson & Boumgarden, 2010). Future research should, therefore, investigate in which cases in ISD an agile team of generalists can perform better and in which cases a hierarchical team structure with several specialists might be superior. Finally, at least some development practices manipulate the relative influence of team learning on software quality in ISD (Maruping et al., 2009). However, which specific developer behaviors are triggered by such practices remains obscure so far. Revealing these behaviors and their underlying mechanisms would constitute a significant step in understanding the relationship between development methodology, team learning, and team performance (Maruping et al., 2009).

5 Conclusion

To the best of our knowledge, we are the first to conduct a literature review of scholarly research on team learning with a focus on ISD. Unlike existing reviews, we thereby account for findings on the specifics of ISD as a complex organizational function. This is in line with recent calls for more domain-specific theories of team learning (Edmondson et al. 2007). Based on the categorization scheme of Edmondson et al. (2007), we examine three perspectives on team learning applied to the field of ISD and highlight their distinct characteristics, assumptions, and limitations: (1) the team learning curve, (2) shared knowledge and group memory, and (3) team learning behavior. In addition to these streams, we identify an innovative approach to research team learning in ISD which takes a structural and relational perspective. We present several aspects which these streams of research can cross-fertilize. We emphasize team leader behavior, learning goals and task characteristics as concepts which ISD team learning research has widely neglected by contrasting team learning in ISD to related disciplines. We also highlight several implications for ISD methodology and management, especially in globally distributed settings and agile development practices. In summary, we hope to contribute to the progress of our field in understanding, explaining, and improving team learning in ISD.

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Chapter 3

SELF-ORGANIZATION AND LEADERSHIP IN AGILE TEAMS: A COMPLEXITY LEADERSHIP APPROACH

Gholami, B. (2015). “Self-organization and Leadership in Agile Teams: A complexity Leadership Approach”. *Leadership Quarterly*

Abstract. *During the past decade, agile Information Systems Development (ISD) approaches have been adopted by many companies to deal with uncertain situations and to respond quickly to environmental change and customer requirements. Generally, agile approaches promote self-organization and encourage decentralized, adaptive and collective leadership. Leadership in the software industry, as in any other industry, is increasingly recognized as an important hallmark of business growth. However, due to the self-organizing nature of agile teams, the important role of formal management and its link to adaptive leadership is largely missing in the literature. Moreover, there are absences of theoretical foundation and empirical evidence on the topic of leadership in the "agile" studies. Research on the topic mainly focuses on the role of leaders as individuals and overlooks the social, relational, and complex context of agile teams in which leadership is a process. Building on the work of Uhl-Bien et al. (2007), this research uses Complexity Leadership Theory and adopts the interpretive case study approach to (1) explore self-organization and leadership in the complex and dynamic context of agile ISD teams, and to (2) understand how adaptive outcomes (e.g., learning and innovation) are facilitated during tensions and uncertain situations.*

Keywords: *Agile Information Systems Development (ISD), Complexity Leadership Theory (CLT), Complex Adaptive Systems (CAS), Self-organization, Disequilibrium, Uncertainty*

1 Introduction

Leadership is of crucial importance to the sustainable success of organizations (Smith & Lewis, 2011). Over the years, researchers have investigated the influence of leadership on effectiveness including such adaptive outcomes as learning and innovation (Clarke, 2013; Edmondson, Dillon, & Roloff, 2007; Uhl-Bien, Marion, & McKelvey, 2007), and performance (Drescher, Korsgaard, Welpe, Picot, & Wigand, 2014; Mathieu, Maynard, Rapp, & Gilson, 2008; Zaccaro, Rittman, & Marks, 2002). Accordingly, leadership is increasingly recognized by organizations as an important hallmark of business growth and consequently has led to large investments in leadership development (Bilhuber Galli & Müller-Stewens, 2012). Over the past decade, there has been increasing interest in leadership in different organizations. Survey results underline this growing interest as well as the increased attention and allocation of resources to leadership (cf. O' Leonard and Krider, 2014).

Furthermore, organizations are facing complex competitive environments driven largely by globalization and technology (Sambamurthy, Bharadwaj, & Grover, 2003). Therefore, there is no doubt for any organization regarding the importance of organizational ability to identify and manage and respond to change (By, 2005). Likewise, in the software industry there is an increasing demand to deliver high quality software more efficiently (McAvoy, Nagle, & Sammon, 2013). In order to handle the unstable, unpredictable user requirements and respond quickly to changing environments, agile Information Systems Development (ISD) approaches have been widely applied in ISD processes (Highsmith, 2002; G. Lee & Xia, 2010), and are progressively seen as a valid solution (Pelrine, 2011).

Consistent with these changes in the business environment, the field of leadership studies is also evolving. Leadership is no longer simply described as an individual characteristic or style (Avolio, Walumbwa, & Weber, 2009), but rather is an emergent, interactive dynamic (Lichtenstein & Plowman, 2009) which focuses on a process that inherently involves multiple individuals (e.g., among peers in a self-organizing team) (Day, Fleenor, Atwater, Sturm, & McKee, 2014). The issue of leadership in self-organizing teams has been explored in related studies (e.g., Barker 1993; Bunderson and Boumgarden 2010; Manz and Sims 1995, 1987). In traditional leadership theories, leadership is conceptualized mainly in terms of individual leader skills, abilities, and

behaviors or other leader attributes that are believed to directly affect team processes and performance (Day, Gronn, & Salas, 2004). However, in the knowledge era leadership is a generative dynamic (Uhl-Bien et al., 2007), which is a function of the processes associated with people working together to accomplish shared work (Day et al., 2004). It is the outcome of the interrelationships of team members, rather than solely an individual input into the team (Day et al., 2004). Overall, compared to conventional teams, leadership in self-organizing teams is a more challenging undertaking (Langfred, 2000; Morgan, 2006).

In the software industry, although the term leadership does not occur in any value or principle of agile ISD teams (Fowler & Highsmith, 2001), there are some indicators that shape the ground of leadership discussion in agile ISD teams (Moe, Dingsyr, & Kvangardsnes, 2009). Agile ISD teams are self-organizing and empowered, but not leaderless or completely uncontrolled (Cockburn & Highsmith, 2001). Over recent years, scholars have tried to elaborate on the differences between management and leadership (McAvoy & Butler, 2009; Vidgen & Wang, 2009; Yang, Huff, & Strode, 2009; Moe, Dingsyr, et al., 2009), and also on the different roles (Hoda, Noble, & Marshall, 2013) in agile ISD teams. Generally, researchers have shed light on the adaptive nature of leadership in ISD teams (e.g., Augustine et al., 2005; Highsmith, 2010). Moreover, the dynamic and changing nature of agile ISD has led scholars to treat it as a complex activity and to use Complex Adaptive Systems (CAS) theory as a theoretical lens through which to examine it (e.g., Kautz 2012; Highsmith 2010; Meso and Jain 2006; Vidgen and Wang 2009). CAS are self-organizing networks of interacting and interdependent agents with common goals, outlooks and needs; they are capable of adapting to the internal state and external environment and respond to stimuli (Benbya & McKelvey, 2006; Holland, 1995; Meso & Jain, 2006; Uhl-Bien et al., 2007). They exhibit the characteristics of both order and chaos (Benbya and McKelvey 2006; Highsmith 2010), and can survive despite a changing environment (Meso & Jain, 2006). To address the CAS theory approach in leadership, Uhl-Bien et al. (2007) have proposed Complexity Leadership Theory (CLT). According to CLT, effective leadership processes in organizations are described in terms of elastic administrative functions that simultaneously enable adaptive dynamics and exploit these dynamics to produce business outcomes for the organization (Uhl-Bien & Marion, 2011). Thus, considering the complex, social, and adaptive nature of agile ISD teams, the importance

of leadership, and the reliance of agile ISD approaches on self-organizing teams an in-depth and exclusive leadership analysis is deemed to be essential.

First, agile ISD teams, as social dynamic networks, are not free from management control (Cockburn & Highsmith, 2001), and this creates a common misconception about little or no role for leaders in agile ISD teams (Cohn, 2010). The important role of management in agile teams is mainly ignored (Appelo, 2011) and to the best of our knowledge there is little empirical support on the topic. Second, as aforementioned, leadership is now conceptualized beyond an individual-level skill (Day, 2000); rather it is described as a shared, relational, and social dynamic (Avolio et al., 2009; Yukl, 2012). The few studies on leadership in agile ISD mainly focus on the role of leader rather than on the process of leadership. Agile ISD teams are not limited to developers; there are many different stakeholders that interact with these teams. As a result, there is a need to further study these teams in a broader and deeper scope (e.g. a dynamic network). Third, scholars need to consider how leadership processes change and evolve as they are influenced by *context* (Dinh et al., 2014; Hazy & Uhl-Bien, 2013b). The self-organizing nature of agile ISD teams, which is designed to help handle the changing environment, creates a proper context in which to study complexity leadership. Therefore, the purpose of this study is *to use CLT as a lens through which to develop an empirically based framework (1) to explore leadership in the complex and dynamic context of agile ISD teams and (2) to understand how it facilitates adaptive outcomes (e.g., learning and innovation) during a situational change*. The study is a multiple embedded case study design and adopts an interpretive stance in a leading software company. In the next section, the theoretical foundation of the study is developed, and then applied in the following sections to guide the empirical exploration.

2 Theoretical Foundations

2.1 Complexity Leadership Theory

CLT has been introduced to leadership research by Uhl-Bien et al. (2007). CLT draws from the complexity sciences to offer a framework for both the administrative and adaptive functions in organizations (Uhl-Bien & Marion, 2009). In the complexity approach, “leadership” is not considered one or a group of individual(s). Rather, it is the identifiable pattern of organizing activity among autonomous and heterogeneous individuals

(Hazy & Uhl-Bien, 2013a). Based on this theory, leadership is viewed as “an interactive system of dynamic, unpredictable agents that interact with each other in complex feedback networks” (Avolio et al., 2009, p. 430). According to this theory, leadership is an emergent phenomenon and can be enabled through any interaction (Uhl-Bien et al., 2007). CLT is built on the following assumptions:

CLT forms a leadership paradigm that focuses on enabling adaptive *outcomes* such as the learning, innovation, and adaptive capacity of CAS in the context of organizational activities (Uhl-Bien et al., 2007). In CLT “the *context* is not an antecedent, mediator, or moderator variable; rather, it is the ambiance that spawns a given system's dynamic persona, it refers to the nature of interactions and interdependencies among agents” (Uhl-Bien et al., 2007, p. 300). CLT has shifted the *focus* of leadership from an individual, or individuals, to the social and relational interactions of heterogeneous agents which form CAS (Avolio et al., 2009; Hazy & Uhl-Bien, 2013b). It distinguishes between *leadership* and *leaders*. In this theory leadership is described as “an emergent, interactive dynamic” that produces adaptive outcomes. Leaders in this theory are considered to be “individuals who act in ways that influence this dynamic and the outcomes” (Uhl-Bien et al., 2007, p. 300). As a result, the *unit of analysis* for CLT is the CAS (Uhl-Bien et al., 2007). The key elements of CLT, as well as their implications for agile ISD teams, are outlined below.

2.1.1 Administrative Leadership

Administrative leadership refers to “the actions of individuals and groups in formal managerial roles who plan and coordinate organizational activities” (Uhl-Bien et al., 2007, p. 306) and seek to gain strategic organizational outcomes. Administrative leadership gives instructions on a task, has an active role in planning, and problem solving/decision making, sets the timeline, allocates resources, sets standards of performance, sets rules and regulations (Faraj & Sambamurthy, 2006; Hoch, Pearce, & Welzel, 2010; Quinn, Clair, Faerman, Thompson, & McGrath, 2014), and challenges and manages organizational strategy (Yukl, 1989). The hierarchical and bureaucratic functions of the organization are represented by administrative leadership. Administrative leadership forms a top-down process and is based on authority and position (Uhl-Bien et al., 2007). It has the power to implement processes, policies, and procedures

(Uhl-Bien et al., 2007), to clarify roles and responsibilities, and to avoid confusions (Hazy & Uhl-Bien, 2013b). In CLT, administrative leadership is supposed to employ its power and authority to leverage adaptive outcomes (Uhl-Bien et al., 2007). It brings about conditions and structures to enable adaptive outcomes, and orients the organization towards dynamic stability (Hazy, 2011; Uhl-Bien et al., 2007).

2.1.2 Adaptive Leadership

Adaptive leadership is "an emergent, interactive dynamic that produces adaptive outcomes in a social system" (Uhl-Bien et al., 2007, p. 306). Uhl-Bien et al. (2007) discuss that conflicting needs, ideas and preferences, as well as asymmetrical interactions are the source of adaptive leadership. Asymmetrical interactions originate from two types of asymmetry: authority and preferences. If an interaction is based on different authority and power, the leadership can be top-down. If the interaction is based on different preferences it might drive interactive dynamics (Uhl-Bien et al., 2007). Hazy and Uhl-Bien (2013b) explain that adaptive leadership influences temporary emergent interactions that individuals experience in their daily activities and changes these interactions to more established organizational routines such as market performance.

Adaptive leadership will be enabled through *context,* which is the interactive environment within which complex dynamics occur; and through *mechanisms,* which are dynamic patterns of behavior that produce adaptive outcomes. Uhl-Bien et al. (2007) add that adaptive outcomes will be developed through *emergence,* which contains two important mechanisms: *self-organization* and the *reformulation* of existing elements. In CLT, adaptive leadership is recognized by significance and impact. Uhl-Bien et al. (2007) define significance as the potential usefulness of new, creative knowledge or ideas, and impact as the degree to which other external agents embrace and use the new knowledge or idea.

2.1.3 Enabling Leadership

CLT brings the attention of leadership research to the importance of enabling and interacting with adaptive dynamics in the context of a formal organizational structure. In CLT the role of enabling leadership is to foster conditions (e.g., context) that leverage adaptive leadership and allow emergence (e.g., self-organization). Uhl-Bien et al.

(2007) discuss that enabling leadership generally catalyzes adaptive leadership and fosters complex systems by (1) fostering interaction, (2) fostering interdependency, and (3) injecting adaptive tension to help motivate and coordinate the interactive dynamic (p. 309).

Additionally, enabling leadership provides meaning to the system (Plowman et al., 2007). Hazy and Uhl-Bien (2013b) describe enabling leadership as a community building function which provokes the sense of meaning and shared identity to the individuals in the system.

2.1.4 Adaptive Outcomes

In CAS the agents constantly interact, exchange information, learn, and adapt their behavior to the circumstances. Behaviors in CAS usually arise from interactions and feedback loops among the agents of the system (Sterman, 2000). Sterman (2000) discusses that CAS consist of feedback loops, and learning arises from the interaction of these loops with one another. This is what Uhl-Bien et al. (2007) call "adaptive outcomes". The outcomes of adaptive leadership are, for instance, new ideas, innovation and change within the organization. To explain adaptive outcomes, Hazy and Uhl-Bien (2013b) elaborate on the concepts of "fine-grain" interactions and "coarse-grain" properties. Fine-grain interactions in the system include day-to-day interactions, relationships and transactions of agents. Coarse-grain properties, on the other hand, are daily norms and regularities on which agents can count without having the sense of uncertainty. Coarse-grain properties are accepted rules, norms, obligations or identifications that can be observed either locally as daily routines or organizationally as policies and strategies (Hazy & Uhl-Bien, 2013b). Adaptive leadership influences fine-grain interactions and facilitates the emergence of coarse-grain properties (Hazy & Uhl-Bien, 2013b).

One of the examples of processes through which adaptive outcomes are likely to be generated is "double-loop learning" (Argyris, 1976, 2002). In double-loop learning, the goal, values, and variables may be questioned, scrutinized, or even rejected and reformulated. Such learning may bring about a change in the way in which strategies and consequences are framed (Argyris, 1976) in a system. Another example is the processes of generating ideas, selecting ideas, and implementing those ideas which are needed for "turning creativity to innovation" (Somech & Drach-Zahavy, 2013). In both examples,

adaptive leadership supports experimentation through fine-grain interactions and facilitates the emergence of coarse-grain properties. In order for the fine-grain interactions to facilitate and produce coarse-grain properties, the system needs to face a sense of *disequilibrium* (Lichtenstein & Plowman, 2009). Disequilibrium reflects "a major disruption in system behavior" (Lichtenstein & Plowman, 2009, p. 620) and creates a sense of instability and uncertainty in the system. The system then tries to adapt to and overcome the situation and comes back to stability through different actions and experimentations (Hazy & Uhl-Bien, 2013b). Overall, in CLT, adaptive outcomes are new ideas and learning which make their way into the system structure and change the way the system operates.

2.2 Agile ISD Teams as CAS

Agility is the ability to rapidly respond and fit to occurring change. It is considered to be an imperative for business success (Sambamurthy et al., 2003). Agility underlines firms' success in "continually enhancing and redefining their values" (Sambamurthy et al., 2003). Within the Information Systems (IS) discipline, Overby, Bharadwaj, & Sambamurthy (2006) have conceptualized agility as incorporating the "sensing and response capabilities" of the firm.

In the context of ISD, agility has been perceived as the ability of "information systems development and deployment methods to swiftly adapt to the changing business requirements" (D. Lee et al., 2006, p. 5). Accordingly, the principles of "The Agile Manifesto"[1] for ISD focus on self-organizing teams and empowered individuals in order to build software products more effectively. Self-organizing teams are fundamental features of agility in software development (McAvoy & Butler, 2009; Cohn, 2010; Hoda et al., 2013). Agile ISD teams are essential social networks that interact intensively (Boehm & Turner, 2004). Therefore, agile ISD changes the role of the project manager from that of a project controller to that of a team facilitator (McAvoy & Butler, 2009).

[1] The Agile Manifesto (http://agilemanifesto.org/), also called the Manifesto for Agile Information Systems Development, is "a formal proclamation of four key values and 12 principles to guide an iterative and people-centric approach to software development" (Rouse, 2011, p. 1).

The process of decision making now resides with the team members rather than with the team manager. Team members learn how to work together and how to mutually oversee the activities of each other (Barker, 1993). Agile ISD puts a greater emphasis on people as well as on social interactions, which requires a higher degree of human communication and learning.

There are many agile methods and practices for ISD. Among them, "Scrum" is a widely adopted agile method (Poppendieck & Poppendieck, 2003; Sutherland, 2004) that includes a project management framework in which development activities such as requirement elicitation, software design, implementation, and testing are conducted together (Highsmith, 2010). Originally, the word "scrum" means "a usually brief and disorderly struggle or fight". Scrum in rugby is "a way of starting play again in which players from each team come together and try to get control of the ball by pushing against each other and using their feet when the ball is thrown in between them"(Merriam-Webster Dictionary). (Figure 1)

Figure 1. Scrum in rugby

For ISD, Scrum was first introduced to the field by Takeuchi & Nonaka (1986). Scrum is both an iterative and an incremental process. The iterative process is constituted by the concept of successive refinement. In this context, a self-organizing development team picks work packages from a prioritized list of customer requirements, which are called backlog items. The product backlog is decomposed into so-called "sprint backlogs", which represent the iterative character of the work process (Cohn, 2010; Hoda et al., 2013). Team members are offered full autonomy over choosing the activities and routines that support them best in developing the required elements of their enterprise software. Hence, empowered with collective decision-making and cross-functional

skills, team members are given significant authority and responsibility for their work (Hoda et al., 2013; Moe, Dingsøyr, & Dybå, 2010).

The Scrum framework includes "associations between Scrum teams and their roles, events, artifacts, and rules, where each component is supposed to serve a specific purpose" (Schwaber & Sutherland, 2011, p. 5).

Scrum Roles

Product Owner (PO): The PO in Scrum "represents the needs of the end customers, controls the software development and collaborates with the development team during the complete project. This role combines product and project management work. The PO is responsible for the success of the software project" (Pichler, 2007, p. 9).

Development Team: The development team "performs all work needed to convert requirements into product increments. In Scrum, software development is team based, which means all roles like architect, programmer, quality controllers, testers and others work closely together" (Pichler, 2007, p. 13). According to Schwaber and Sutherland (2011), the development team is cross-functional and does not contain sub-teams.

Scrum Master (SM): The SM acts as coach and change agent. The SM supports the team on its path to becoming a high performance team, and protects the team from external interferences and disturbances regarding operational undertakings and removes impediments (Pichler, 2007; Schwaber & Sutherland, 2011).

Scrum Artifacts

Product Backlog: A prioritized list of business and technical functionality that is evolving and has to be developed into a system (Schwaber, 2002).

Sprint Backlog: Schwaber and Sutherland (2011, p. 8) illustrate a sprint as "a time-box up to four weeks, where a useable product increment is developed". The Sprint Backlog consists of the set of tasks that were selected by the team from the Product Backlog for a Sprint (Schwaber 2002).

Scrum Events

Scrum defines the following regular meetings during a sprint (Pichler, 2007; Schwaber & Sutherland, 2011):

Planning: In this meeting the estimation of the planned features for the next sprint is carried out by the Scrum team.

Daily Scrum: The daily Scrum is a short (15-minute) meeting for coordination and setting a plan until the next daily Scrum meeting**.**

Review: The review meeting at the end of the sprint inspects the product increment that has been developed during the sprint, and makes the project progress transparent.

Retrospective: The retrospective is a meeting in which where the Scrum team audits itself after the sprint review meeting, and creates strategies for improvements.

Figure 2 visualizes the roles, events, artifacts and rules of Scrum.

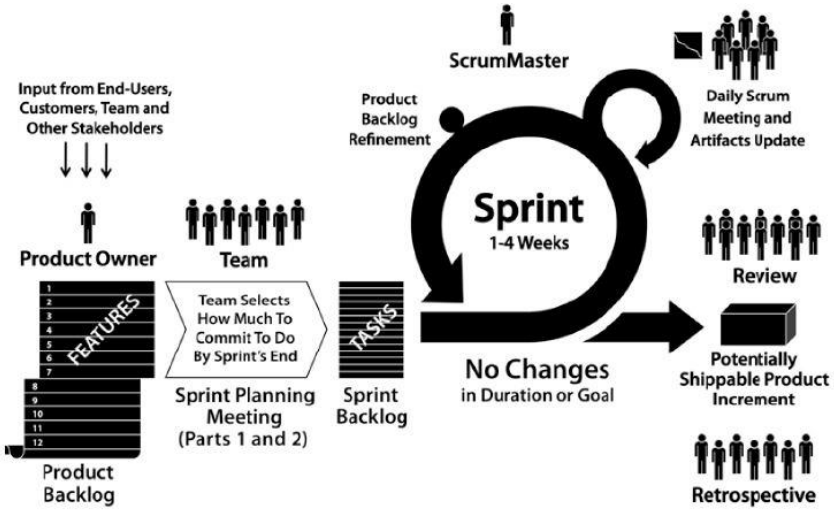


Figure 2. Scrum processes, events and roles (Schwaber & Sutherland, 2011)

2.3 Agile ISD and Complexity Leadership

As an agile ISD promoter, Highsmith (2010) claims that CAS is an appropriate theory for software development. Vidgen and Wang (2009) argue that CAS theory holds promise for deepening our understanding of agile ISD. Since CLT is derived from CAS theory, there are several grounds for making CLT an appropriate lens through which to study leadership in the context of agile ISD teams:

First, in CAS members spontaneously come together to perform a task or decide upon what task to do, and how and when to do it (Mitleton-Kelly, 2003). *Self-organization* is an attribute of CAS (Sterman, 2000) and is an *emergent* phenomenon (Vidgen & Wang, 2009). An agile ISD team is self-organizing and is considered to be democratic, without a strict hierarchy (McAvoy & Butler, 2009; Cohn, 2010; Hoda et al., 2013; G. Lee & Xia, 2010; Gholami & Heinzl, 2013). Self-organization indicates that all agents participate in the design, shape and evolution of the team through local interactions

(Stacey, 2011). Second, in CLT, adaptive, creative, and learning actions are likely to emerge from the interactions of CAS as they strive to adjust to tension, constraints or perturbations and *changes* (Uhl-Bien et al., 2007) and as discussed this was one of the reasons that agility was introduced to ISD. Agility in ISD is defined as "the continual readiness of an ISD method to rapidly or inherently create *change*, proactively or reactively embrace *change*, and learn from *change* while contributing to perceived customer value (economy, quality and simplicity), through its collective components and relationships with its environment" (Conboy, 2009, p. 340). Thus, agile approaches aim to enable fast communication, adapt to rapidly changing environments, and achieve desirable products with lower risks (Barlow et al., 2011). Third, agile approaches endorse multifunctionality and multiskilling (Hoda et al., 2013; Pearson, 1992; Vidgen & Wang, 2009) and aim at *adaptive outcomes* such as continuous learning and adaption (Henderson-Sellers & Serour, 2005; Vidgen & Wang, 2009). To map CAS theory to common agile development practices, Meso and Jain (2006) and Highsmith (2010) discuss that ISD evolves through many complex interactions. By allowing complex interactions and dynamic and effective interplay between those interactions, agile methods in ISD enable organizational adaptation and the ability to respond quickly to change and uncertainty. CAS theory provides a groundwork for dynamic interplay among people, process, and product dimensions (Meso & Jain, 2006), and for the concept of emergence and factors leading to emergent outcomes (Highsmith, 2010). CAS theory also explains how agile methods enable such interplay and outcomes.

In terms of CLT key components, studies on agile ISD mainly focus on the role of one individual or a group of individuals rather than on an emergent interactive process. Also, agile ISD studies typically shed light on decentralized and adaptive leadership. For instance, Augustine et al. (2005) argue that an agile leader is an adaptive leader, while Highsmith (2010) discusses that agile IS development is a shift from command and control management to an adaptive leadership. Highsmith (2010) argues that to deal with a highly changing environment and to leverage adaptive behaviors such as innovation, creativity and learning, leaders of agile ISD teams are meant to provide subtle feedback and direction, coordinate members, obtain resources, and motivate the agents. An agile ISD team should also be able to self-organize its challenges and constraints which have been posed by management (Cockburn & Highsmith, 2001; Cohn, 2010; Moe et al., 2010). McAvoy and Butler (2009) consider the high level of

empowerment in cohesive agile ISD teams to be a negative factor and call for the reassessment of role of managers as devil's advocate in the decision-making process in such teams. Nevertheless, administrative leadership is mostly overlooked in agile ISD studies. There is no clear discussion on actions of formal leadership and its effect on adaptive outcomes in the ever-changing and dynamic context of agile ISD. Moreover, there is a need to investigate the function of enabling leadership that catalyzes CAS dynamics which promote adaptive leadership and acts as an entanglement between administrative and adaptive structures. The question of how enabling leadership facilitates conditions so that an agile ISD team would be able to optimally address creative problem solving, adaptability, and learning, still requires an answer. In summary, the theoretical basis presented above provides the structure for the empirical exploration of the study.

3 Research Design

ISD processes are "made and enacted by people with different values, expectations, and strategies, as a result of different frames of interpretation" (Vidgen & Wang, 2009, p. 359). Since the objective of this study is to understand how leadership occurs in the context of agile ISD teams to facilitate adaptive outcomes during the change, the study emphasizes complex interactions and the interplay between those interactions as subjective, and considers the dynamic interplay among people, process, and product to be socially and relationally constructed. Therefore, the nature of this study is qualitative and adopts the interpretive epistemological stance (Walsham, 1995, 2006). The case study is considered an appropriate empirical research method for the investigation of real-life contexts such as the complex dynamic context of agile ISD, where control over the context is not required or possible (Yin, 2009). I adopt multiple embedded case studies in one software company. This allows access to different interpretations of concepts, and gains a richer and deeper understanding of leadership processes and adaptive outcomes during change.

3.1 Research Context and Sampling

As aforementioned, in CLT the context refers to the nature of interactions and interdependencies among agents and there is a need to consider how leadership processes change and evolve as they are influenced by the context. This favors the

discussions of Johns (2006) on the importance of research context on organizational behavior. He argues that context can be a set of "situational opportunities" for, and "countervailing constraints" against, organizational behaviors. He also discusses that context can be a shaper of the meanings underlying organizational behaviors. Considering these discussions for the research, I explain the research context of the study in detail.

This study was conducted in a leading software corporation in which agile development and practices have been in place for more than five years in order to increase the efficiency in developing enterprise software products. I study a "representative" organization in terms of the implementing agile ISD and consisting of self-organizing teams, as well as a high-tech fast changing environment (Patton, 2002). Scrum has been chosen as the main agile development method in the company but various sub-sets of agile practices have been adopted by teams, and the scrum is tailored from team to team. The company has several locations all around the world. The company values people empowerment, respects team autonomy, and believes in an open environment where people can easily speak up, trust each other, and share their knowledge. In the company, agile ISD teams are treated as self-organizing and empowered to selectively implement or change particular techniques according to their own need and situation. Team members have autonomy over choosing their task and how to perform the task. However, the company still has difficulties empowering employees facing reluctant colleagues to take over their responsibilities, or dissatisfied employees regarding the management system. Despite having multiskilled and highly expert employees, the managers still face the challenge of how to lead the company's self-organizing ISD teams to give them autonomy while guiding them within company's strategy and objectives. Below I elaborate more on the context of the division in which data was collected.

Data collection was carried out in a large division in the company (SoftDiv). SoftDiv is the most global division in the company and is composed of Scrum teams distributed across the world. The task of SoftDiv is regarded by senior management as highly perturbing and changing. Teams in SoftDiv are responsible for reacting quickly to legal changes in countries. Each Scrum team consists of 5 to 15 team members. The Area Product Owner (APO) is responsible for a geographical area in which multiple Scrum

teams have a unique product scope. Each Scrum team has one Product Owner (PO), ensuring that the team delivers value to the business, and translating business requirements to software components. Each PO is in contact with the Local Product Manager (LPM). The LPM is responsible for transferring customer and business requirements to the PO. Also, multiple Scrum teams with a unique product scope are managed by the Line Manager (LM). The LM is known as the people manager and is responsible for human aspects of Scrum teams. They make sure that the product scope is in line with company strategy. The LM is also accountable for employee performance. In the company, the task of Scrum teams in SoftDiv is generally regarded as one of maintenance. Nevertheless, teams in SoftDiv also have to do development. The development work needs to deliver software products or services that meet customer requirements. Moreover, the development work needs to take previous software architectures into account in order to deliver compatible and consistent software products or services.

The Scrum teams work on the software that has already been developed by a team called the Core team. The Core team is responsible for general development and each team in SoftDiv is responsible for localizing the general software for each county. This means for example that for public sector software packages the Scrum teams need to adhere the development work to regulatory requirements in order to achieve regulatory compliance for each country. The PO of one of the teams explains their task regarding the taxation software:

"The core team is in general responsible, let's say, for [the] topic 'tax calculation' in general. That tax calculation and the tax reporting in general works. But each country has special regulations regarding the tax which every time change. These specifications also need to be amended or implemented. This is our task in the [SoftDiv]."

For maintenance, customers usually request their needs regarding improvements or errors in the software, through customer messages. Moreover, for any missing functionality or any legal change that has not yet been implemented, the Scrum teams in the SoftDiv have to do development. Figure 3 illustrates the general topology of a Scrum team in SoftDiv. As the figure shows, there are some other roles in the Scrum team, such as the Architect (Arch), who is responsible for the technical software architecture, and the Quality Engineer (QE), who is responsible for quality of the

software. Moreover, each team assigns some other roles to each developer according to the need of the team and skill of the developer. Consequently, some developers may have more than one role in the Scrum team.

Overall, the fast changing environment, the presence of many different Scrum teams, roles, dynamic interactions, and interdependencies in SoftDiv (as indicated by senior management) make SoftDiv an appropriate context for the study. In this study the unit of analysis is considered to be the Scrum team as shown by Figure 3. Following the company's role specification, I consider the APO, the LM, the PO, and the LPM as *formal roles*.

3.2 Data Collection

For data collection I first contacted the manager of the Delivery and Quality Operations (DQO) team in SoftDiv. The DQO team consists of 17 team members and 4 sub-groups. Each group is responsible for one aspect of the task for SoftDiv (maintenance, new development, quality standardization, and quality testing). The manager of the DQO team has a weekly meeting with all APOs in the division to exchange news and challenges, and to decide on

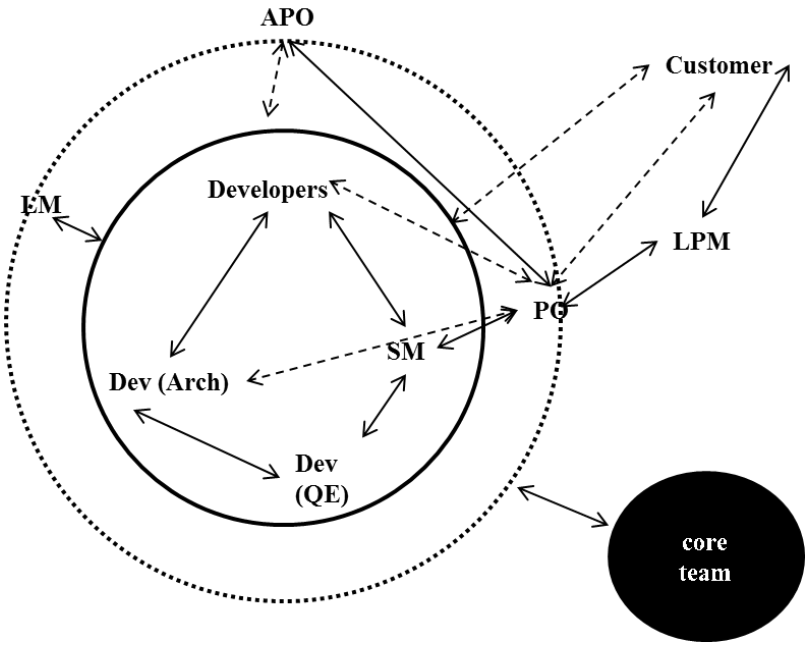


Figure 3. The general network topology of teams (dashed lines are examples of connections between agents which may or may not occur) – Roles are as follows: APO: Area Product Owner, LM: Line Manager, LPM: Local Product Manager, PO: Product Owner, SM: Scrum Master, Dev: Developer, Arch: Architect, QE: Quality Engineer

upcoming strategies. Basically, the DQO team is responsible for development and maintenance operation excellence according to the company strategies by ensuring consistency, transparency, risk assessment, and governance across all units. Thus, the DQO team was connected to all Scrum teams in the SoftDiv. After initiation of the project, I began observing the team meetings of the DQO team. Team meetings observed were basically the internal DQO team's meeting, the subgroup meetings with other Scrum teams, and the weekly APO meetings. I was also granted access to relevant internal documents (e.g., internal wiki pages, company survey results in SoftDiv, etc.). The observation took place between January 2013 and May 2014. In total, 20 meetings were observed.

I was introduced to the APOs by the manager of the DQO team, then interviews were conducted following a snowball sampling procedure (Patton, 2002). First, the APOs were interviewed, and then asked to introduce the key persons in their teams who are both closer to agile ISD teams and can provide rich and critical information on the leadership. When no new information was revealed during the last interviews, the data collection was terminated. Table 1 shows the data collection overview. The interview phase took place in the period between June 2014 and August 2014.

Data was collected as part of a larger research program on leadership and learning in ISD. I had joined the company as a research associate and a part-time employee in June 2011. This enabled me to become involved in daily practices of Scrum teams and become familiar with company culture, structure, and shared language. During these three years of unique ethnographical experience, I gained deep insights about Scrum and software development in the company, secured access to company surveys and internal documents, and talked to many Scrum mentors, managers, and developers.

After observations and taking notes and memos, the interview protocol was designed. Data was primarily collected through semi-structured interviews. Additionally, the "critical incidents technique" was applied in order to encourage interviewees to focus on the events of interest, corresponding with critical situations (Miles & Huberman, 1994). Semi-structured interviews began with generic questions, inviting respondents to share

their experience in different situations including turbulent and uncertain situations, critical roles, and relationships and lessons learned[2]. Depending on the location of interviewees, the interviews were either conducted either face-to-face or via telephone call. Each interview lasted between 45 and 90 minutes. The data collection resulted in several hundred pages of transcripts. Data is rich and diverse enough to make it appropriate for studying complexity leadership in agile ISD.

Table 1. Data collection overview

Location	**# Scrum Teams**	**APO**	**LM**	**PO**	**SM**	**Developer**	**Total # Interviews**
Brazil	6	2	1	5	6	5	16
Germany	5	1	2	5	-	4	12
Czech Republic	4	2	2	4	3	2	10
Russia	2	1	-	2	2	1	5
India	8	4	1	8	7	6	20
China	3	2	-	3	3	1	8
Total (Scrum Teams)	28	12	6	27	19	20	71*
The DQO team	-	-		-	-	-	17 Total: 88

*Some of team members had more than one role

Among all data collected, I selected data based on interview quality and explicitness, equal number of teams (4 teams, each country, 34 individuals), and role homogeneity. Table 2 shows the final overview of the teams and role indicated in the data collection process.

[2] See the Appendix for interview guidelines

Table 2. Final data overview

Location [a]	Brazil				Germany				India			
#APO Interviewed	2				1(LM)				4			
Agile ISD Team	B1	B2	B3	B4	G1	G2	G3	G4	I1	I2	I3	I4
Roles Interviewed [b), c)]	PO, SM	PO, SM, Dev.	PO, SM(Dev), QE	Dev(QE), SM	LM, PO, Dev(QE)	LM, PO, Dev(QE)	PO, Dev(QE)	PO, Dev	PO, SM	PO(LM), Dev	PO, SM	PO, SM
#Interviewees In Team	2	3	2	2	3	3	2	2	2	2	2	2

[a)] Based on the location of the APO [b)] Some interviewees have more than one role [c)] For quotation I used an ID for the interviewee based on the team and the role. For example, B3/SM(Dev) means the Scrum Master (who also has the role of Developer) from team 3 in Brazil.

3.3 Data Analysis

For data analysis, this study specifically uses "constant comparative analysis" to identify and refine emerging categories (Strauss & Corbin, 1990) in which leadership occurs as a "function of interaction" (Uhl-Bien et al., 2007). The process involves both an inductive and an abductive approach (Bryant & Charmaz, 2007). The abductive approach involves applying an established theory, observing surprising empirical phenomenon in light of the established theory, and articulating a new interpretive theory that resolves the surprise (Alvesson & Kärreman, 2007). I used mainly induction to develop the initial codes regarding the different situations an agile ISD team faces and the different influences of Scrum on the system. In parallel, I used abduction to build upon the CLT framework, and remained open to surprising empirical phenomenon.

During my observations, informal talks, interviews, and coding processes many memos were written. The memos consist of important and newly emerging themes as well as linkages to the theory. The memos were gathered over three years of work and observation in the company, as well as observation and data collection of the current study. During the interviews and coding, as part of constant comparison process, I went through several iterations between many sources of data: previous and current memos and observations, and internal documents. Furthermore, the initial codes and preliminary results were presented several times in the company. I had regular meetings with the manager of DQO and two experienced Scrum mentors in the company. Also,

the initial results were presented to a large audience in the company, including many of the interviewees, during a knowledge transfer session as a process of checking and validating interpretations with interviewees (Flick, 2009). The interview with the DQO team was another source of cross-inspection. These iterations helped ensure that the emerging categories were supported by data from different sources. I conducted the analysis using the NVivo 10 qualitative data analysis software from QSR International. In the next section, I reflect on the findings and present empirical data.

4 Key Causes of Disequilibrium in Agile ISD Teams

As previously explained, agile ISD teams are designed to better deal and cope with uncertainty and change. Moreover, emergence will happen when the system faces a sense of disequilibrium and instability from internal and external conditions (Lichtenstein & Plowman, 2009). Basically a pressure, perturbation, or challenge stimulates a system to react and adjust (Lorenz, 1995; Uhl-Bien & Marion, 2009). These challenges generate a tension which fuels the system to create new ideas, and changing relationships and structures is a way they can respond to such a challenge (Uhl-Bien & Marion, 2009). In the current study I asked team members to talk about any kind of situations that cause instability and pressure for their teams. Three key sources of *tension* in agile ISD environment were revealed. These sources of tension are as follows: *requirement uncertainty, task uncertainty, and resource uncertainty* (Table 3).

Table 3. Key causes of disequilibrium for agile ISD teams

Requirement Uncertainty	**Task Uncertainty**	**Resource Uncertainty**
• Lack of details of functionality and business context • Ambiguous and unclear information • Requirement changes	• Unexpected dependencies between tasks • Unclear task sequences and processes • Novelty of the task	Human • Absence • New team member integration • Unclear role and responsibility Equipment • System/Platform Interruption Time • Underestimated work effort • Urgency (Deadline)

First, as scholars have discussed, requirement determination is the most crucial phase in ISD (Browne & Ramesh, 2002). In agile ISD, uncertainties regarding requirements can occur through a lack of details about functionality or insufficient understanding of the business context, ambiguous information, or unexpected changes (Dönmez & Grote, 2013).

In the studied agile ISD teams, the LPM or the PO are usually supposed to help solve such issues by contacting the customer and giving instructions about requirements, including what is expected, how it is to be done, and the timeline.

"From each country we have one LPM or two depending on the requirements. So we get the requirements from the LPMs and also the legal changes. Then they contact our product owner through mail or phone." (G2/Dev(QE))

Usually, requirements cannot be changed during an on-going iteration or sprint (Schwaber, 2002). However, the interviews pointed out that the unexpected requirement change occurs any time before or after the completion of development.

"If it is before the completion of development we can still incorporate changes. But if it is, you know, after it has been delivered to customers it is a little more complex." (I4/APO)

"I mean most of the time it comes via a surprise, but okay, the government has passed a new law, a new rule and it has to deliver all these legal changes at the earliest, as soon as it is possible." (I1/PO)

The second tension is task uncertainty. In ISD, task uncertainty usually occurs when there are unexpected dependencies between the tasks, which means the software components are technically dependant (Dönmez & Grote, 2013), tasks have to be performed according to a specific sequence or process (Espinosa, Lerch, & Kraut, 2004), or the nature of the task is novel and non-routine (Houghton & Yoho, 2005). In this study, dependencies of the tasks usually occur between the agile ISD team and the core team as explained.

"All functionalities from [SoftDiv] have dependency because [the core team] deliver[s] the baseline and we deliver the on top." (G2/PO)

Despite being aware of dependencies between the agile ISD team and the core team, unexpected dependencies sometimes cause a serious tension within teams, which leads to escalation and de-commitment of the task.

"But it can happen that because of core dependencies the topic should be de-committed and should be taken for the next release. And then we have to deal with this. De-commitment is actually not our fault […]. Because for the core colleagues they are also very strict with their time and if we come [across] a big development in the middle of the release to be done immediately, this is not always possible." (G1/Dev(QE))

The third tension is resource uncertainty. I define resources as any means needed for ISD processes, such as human resources, time and equipment. Dönmez and Grote (2013) have characterized human resource uncertainty with regard to the availability of human resources as well as the time span for new team members to become productive. Members in an agile ISD team should have multiple skills, so that they can perform each other's job and substitute and back each other up if needed (Moe, Dingsøyr, & Røyrvik, 2009; Vidgen & Wang, 2009). If one team member leaves or is temporarily absent, the remaining available members have to work on the affected tasks. In this study, uncertainties regarding the human resource are revealed as the planned or unexpected absence or leave of a team member. For planned absence or leave, the agile ISD development usually suggests backup team members. However, the findings show that despite all suggested backup techniques in agile ISD processes, if the leave or absence is unplanned or the nature of the task is highly complex, they cause a tension for the team.

"There are even some areas where only one person in the team knows that particular area. So if it is an urgent customer thing we tell the customer to wait. You know, we have to basically wait till the [responsible] person is back." (I4/APO)

Surprisingly, the findings show that agile ISD development's emphasis on multiskilling and backing up expertise in the team may reduce the risk of leave or absence but at the same time it creates some overlapping roles and unclear responsibilities. Also, in the studied agile ISD teams the overlapping roles and responsibilities might have happened because of different role definitions.

"So there is an overlapping between PO architect and Scrum Master, PO and QE sometimes, so that leads to a little bit of confusion in the sense like who would do it or

who should do it, so I mean task by task I just decide who can take it up and I write to them." (I3/APO)

Furthermore, the findings show that integrating new team members in the agile ISD will become a tension when there is a high need for human resources and the tasks are short cycled and should be delivered within one or two sprints. This is because the learning processes takes time and cannot happen within one or two sprints.

"They allocate some C-users[3] *to the team to help us. They weren't able to be so useful since for them it takes so long to learn and once they have learned, they should leave."(G4/Dev)*

Additionally, time uncertainty points to the importance of urgency in which a particular team is situated. It indicates the extent to which time pressure influences agile ISD team activities. This study finds that time resource uncertainty is one of the tensions of the studied agile ISD teams in the research. A lack of time is usually considered to be an inhibitor of adaptive outcomes such as learning and creativity.

"There is no time for let's say bringing some new topic in. If this person has a new idea he has to basically do it in his own free time." (G1/PO)

Data shows that the equipment tension is related to interruptions regarding the software platform in which the team is working. Generally, the studied agile ISD teams do their development, maintenance, and testing on an integrated ERP systems. Findings show that sometimes it happens that this system is unexpectedly down and the agile ISD team is unable to perform its task.

"It is very common [that the system is down] and it affects many aspects of our work." (B3/SM(Dev))

While I do not claim that I cover all possible tensions an agile ISD team faces, I nevertheless believe that the current findings will be enough to enable the discovery of the self-organization patterns in agile ISD teams.

[3] C-users are developers or software experts from other companies who are temporary hired in the company for a specific situation or time period.

5 Self-organizing Mechanisms in Agile ISD Teams

The inductive analysis of data shows that there is a heavy reliance of agile ISD teams on technical knowledge. CLT distinguishes between adaptive and technical problems. Adaptive problems require new learning, creativity, and new patterns of behavior for problem solving (Heifetz, 1994), whereas, technical problems can be solved with knowledge and procedures already in hand (Parks, 2005). Despite the focus of CLT on adaptive problems, analysis has revealed that in agile ISD teams complexity leadership will occur also to produce solutions to technical problems. I will elaborate more on the differences of technical and adaptive problem solving in section 5.2. I found two general mechanisms of self-organization through which an agile ISD team reacts to the three aforementioned tensions: *information/knowledge diffusion* and *osmosis*. Below, I explain these two mechanisms and explain how the studied agile ISD teams self-organized themselves to reduce or handle the tension and come back to equilibrium.

5.1 Information/Knowledge Diffusion and Osmosis

Generally, when a tension puts an agile ISD team under pressure, the first activity will be searching for appropriate pieces of information or knowledge. The nature of information or knowledge being searched for and diffused is different according to the tension introduced to the system. The information or knowledge then will flow among the team members (agents) in the ISD team. We term this mechanism “diffusion”. Knowledge diffusion in the literature is defined as a process when knowledge flows between geographically dispersed networks (Ernst & Kim, 2002; Singh, 2005). The findings explain the process of diffusion as follows: when the tension is injected into an agile ISD team, the team transcends most of the agile roles and pre-defined meetings and connections, and seeks the source of information or knowledge. This means that the network of agile ISD team members will become a “solvent” by which to dissolve information or knowledge. When the source(s) of information or knowledge is/are found, the team tries to diffuse it/them through Scrum meetings so that the entire team will be informed about it or learn it. The speed of the information or knowledge diffusion depends on the capacity of team members to absorb the information or knowledge. The source of information or knowledge might be one or a group of experienced, highly skilled and high performance team member(s).

However, the findings show that information or knowledge is not always evenly diffused across the system. In this case another mechanism will emerge. We term this mechanism "osmosis" (Doorewaard & Bijsterveld, 2001). In biology, osmosis is defined as "movement of a solvent through a semi permeable membrane into a solution of higher solute concentration that tends to equalize the concentrations of solute on the two sides of the membrane" (Merriam-Webster Dictionary). In the dictionary it also means "an ability to learn and understand things gradually without much effort". In this study I define the "semi permeable responsibility membrane"[4] as a layer that emerges in an agile ISD team during tension and after the team's effort in information/knowledge diffusion. This layer emerges from "the sense of responsibility and trust that an agile ISD team casts on the member(s) who are the source(s) of information/knowledge". Osmosis in this study indicates the team tendency to return to equilibrium even in the case that the information or knowledge is very complex to diffuse across the entire agile ISD team. When osmosis happens, the knowledge diffusion only occurs among team members who are able to fight the barriers of task complexity but at the same time remain obliged by the sense of responsibility and trust which the team casts on them. All other team members act as agents who can cross the "semi permeable responsibility membrane" to reduce the pressure on the other side by taking the responsibility to do the other necessary tasks which are less complex or need less expertise. Table 4 illustrates these two mechanisms.

I now will elaborate on the two mechanisms during the four aforementioned tensions. I also present some evidence from the findings.

5.1.1 Requirement Uncertainty

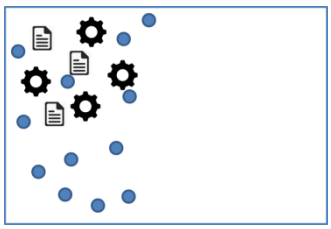
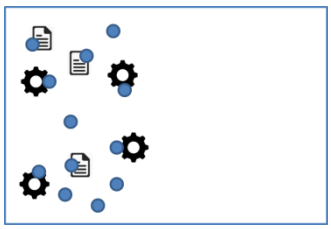
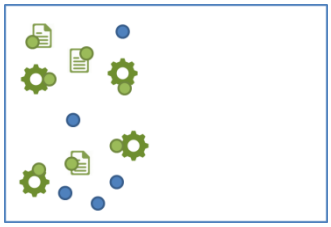
In the case of requirement uncertainty, the studied agile ISD teams first try to contact the LPM. The formal network setting is that the PO and the LPM should communicate directly to understand the requirements. If the requirement change is very urgent and if

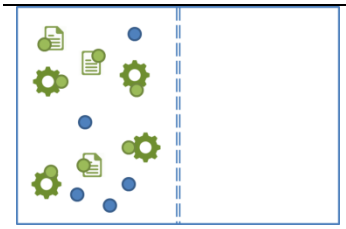
[4] I borrow the terms from biology; however, I do not claim that they refer the exact concept.

the PO does not get a clear requirement description from the LPM, s/he bypasses the LPM and tries to contact the customer directly.

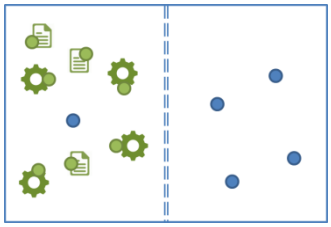
"Usually we have a discussion with [the] LPM, he is in the end responsible for reading and understanding law and indicating what is expected according to this law. But usually we have misunderstandings. At the end if that is not clear or the requirement is very, very ambiguous or very big or there are different possibilities [to implement it] usually we call the very active customers, […] and discuss this to get the common understanding." (B2/PO)

Table 4. Diffusion and Osmosis mechanisms in agile ISD teams in times of tension

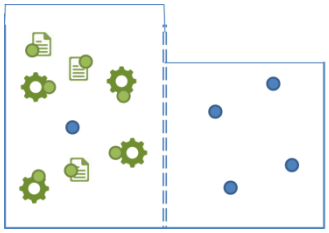
Mechanism	Explanation
	It depends on whether handling the tension needs any requirement clarification from customer or any technical knowledge to do the task. Even if it concerns the requirement from the customer, the agile ISD team needs experts to implement the requirements.
	(1) Requirement or task is offered to the agile ISD team to perform (diffusion).
	(2) During times of tension the agile ISD team transcends any Scrum role or structure and any team member is willing to accept the ownership to do the task (diffusion).
	(3) However, not every team member is the source of information or has the expertise to do the task. Therefore, only some experts will take the ownership of doing the task (diffusion).



(4) During a tension, the agile ISD teams cast the responsibility on the owners of the task. This creates the "semi permeable responsibility membrane" (osmosis).



(5) To bring the team back to equilibrium, the members who were not able to take the responsibly will pass the "semi permeable responsibility membrane" (osmosis).



(6) This means the agile ISD team now gives more resources to the expert side and other team members will take over some necessary but less urgent tasks (osmosis).

It is not always the PO who contacts the LPM or the customer; when the team urgently needs to gain clarifications about the requirements, any of the team members may contact the LPM or the customer. However, country law sometimes makes such illumination more complex, for example when the requirements are from a non-English speaking country. In this situation the PO and the team face challenges regarding language barriers. There are cases when neither the LPM nor the customer could clarify requirement changes; usually the PO is then expected to interpret the law and bring it to the team.

"[…] now in Belgium it's not that easy, or this is in the end not easy for development teams who do not have native people in their team from those countries. But in my case it is something different, because I am a native Dutch speaker. So […] in Belgium I was reading the documents from the authorities in Belgium myself. […] we receive the specifications from the LPM in English but once I have a question I am doing an investigation myself."(G3/PO)

During the process of requirement classification by the PO, the other expert team members will begin the investigation. In a situation where the team cannot clarify the requirement, they begin implementing their basic assumptions about the requirement. The information gathered by the PO or any other team member will be diffused to the team.

The Architect, as an expert, also has a key role in implementing the assumptions because basically it is the PO and the Architect who approve the feasibility of assumption.

"We make estimation for example for [requirement]. And usually we try to avoid this by a good investigation from the responsible developer or architect […] that person [has] a technical background. He knows the product very well; he is already giving some hints where the implications of those requirements or changes are." (G3/PO)

"Sometimes if it is very urgent, we just take the risk and do something about [requirement change]." (B3/QE)

Data revealed that during the processes, many leadership practices take place to bring the agile ISD team back to equilibrium. Table 5 illustrates practices which occur during requirement uncertainty to leverage information diffusion and overcome the tension.

Table 5. Practices to leverage information diffusion and osmosis during requirement uncertainty

Leadership	**Practices**
Administrative	-Use default Scrum setting to connect to source of information
	-Translate requirements
	-Avoid accepting ambiguous information
	-Share technical requirement language
	-Identify the key customer
	-Give autonomy to the team to connect to the source of information
	-Document requirement specifications
Enabling	-Enable the interconnections between sources of information
	-Establish a meaningful relationship with customers
	-Promote awareness about the importance of requirement change
	-Develop sympathy with the customer
	-Enable the team to take risks over implementing the requirement
Emergent	-Transcend Scrum roles and structures
	-Establish consistent patterns to get the information from customers
	-Use trial and error

5.1.2 Task Uncertainty

In the studied agile ISD, task dependencies usually occur when different aspects of the task are overlooked during planning meetings. This may also happen due to the technical complexity of the task, which prevents team members from recognizing the de-

pendency. Basically, the solution would be to detect the dependency and ask the owner of the original task to resolve the problem.

"*We collect all these backlog items and try already to align with counterparts when and which point of time, are you ready so that you can build on your deliverables or solutions." (G2/PO)*

The agile ISD teams can soon recognize such dependencies during daily Scrum meetings. However, when the dependency emerges very unexpectedly the teams seem to bear serious impediments or delays towards delivery. The findings show that first the team tries to refer to an experienced member in terms of software architecture to find out the task sequences and the solution to resolve the situation. If the dependency is internal and can be solved within the borders of the agile ISD team, the knowledge diffuses into the agile ISD team during daily meetings.

"[In terms of dependencies] I mean it's difficult […], now they would look for a solution to how we come out of it now with a different set of people right now. So that tendency is there and obviously people who get frustrated, get confused and then they look for more guidance in terms of how do we do about it. Yes, it becomes a chaotic situation where then probably a senior colleague has to step in and then probably show some way or how to do it well."(I1/PO)

Subsequently, the osmosis mechanism occurs. This means that the team members who are responsible for the task will begin working intensively on the serial task and withdraw from performing other tasks. If their task is categorized as a high priority task, then other team members will take over the responsibility of the highly prioritized task to balance the workload.

"[If] we need something urgent to start doing another task and we realize [that] we have this dependency […] for example, then, I would say what we basically do is to re-plan the tasks and re-prioritize them. So we have to wait and do other tasks."(B3/SM(Dev))

"The moment it is dependent, we try to say that these two tasks are dependent, so we identify who are the two people who are working on that, in the planning meeting we

announce that, so that [the team] is aware that they need to complete those tasks first so others take care of their customer messages." (I2/APO)

However, data shows that if the dependency is an external dependency to the Core Team, the agile ISD teams need to stretch the task to the next sprint while waiting for the Core Team to get the task done.

"But right now we don't have any other options other than waiting or coordinating or directly contacting the person who is responsible, whoever is responsible for [those] dependent objects [in the Core Team]."(I4/PO)

Table 6 lists practices which occur during task uncertainty to leverage diffusion and osmosis and overcome the tension.

Table 6. Practices to leverage information diffusion and osmosis during task uncertainty

Leadership	**Practices**
Administrative	-Provide the big picture on the software
	-Help avoid impediment by distributing parallel tasks
	-Provide organizational resources such as training
	-Provide granular tasks
	-Prioritize tasks
	-Give autonomy to the team to performing the task
	-Follow Scrum processes
	-Leverage formal connections between dependent teams
Enabling	-Make sense of autonomy for doing the task
	-Provide autonomy to customize Scrum artifacts
	-Make sense of tasks by providing the sense that the team makes an impact on the company
	-Enable transparency in daily meetings
	-Reassure granular backlog items
	-Provide awareness about members' ability and competency to do the task
	-Inject discussions (tensions) on how to do novel tasks
Emergent	-Use trial and error
	-Acknowledge dependencies

5.1.3 Resource Uncertainty

Generally, in Scrum, knowledge should not be centralized. There should be no separation of functional roles, and team members should be able to perform a wide variety of tasks (Hoda et al., 2013; Vidgen & Wang, 2009). This is called multiskilling or multifunctionality. There are varieties of agile practices through which agile ISD team members can strengthen the multifunctionality of team members. In the studied agile ISD teams the tension of unexpected absence or leave of a team member is moderated through "pairing". Pairing is about pairing up with a more experienced and skillful team member, either to get to know about the specific task that the member is doing, or to acquire new skills. Pairing is a mutual way of learning and feedback in the studied agile ISD teams, and also indicates role rotation between two team members.

"I mean as we are in Scrum team we always try to make not a one-person ownership. But we always try to do pair programming, so that it helps when person leaves or other person knows the actual, the depth of the topic." (G2/Dev(QE))

Apart from formal training, the agile ISD team will also assign a mentor to integrate the new team member. A mentor is an experienced or skillful team member. The mentor diffuses knowledge to new team member through pairing. However, not only the mentor, but also the entire team diffuses information or knowledge to the new team member through various and numerous feedback loops. One method is the "knowledge transfer" session, in which the entire or sub-group of the team contributes to information or knowledge diffusion. In fact, it was noticeable that the studied teams mostly use pairing and knowledge transfer sessions in case of either leave or absence of a team member, or integrating a new team member.

"We will organize a knowledge transfer session, we would record [those] sessions, [and] we would write a document about this session. Recording session is something which in the meantime is also widely used."(G3/APO(LM))

Pairing, knowledge transfer sessions, and documentation are all process of knowledge diffusion. In the case of very high tension and the need for the team needs to compensate, osmosis will occur.

"The mentor is a driver, is a mentor who would not take over all responsibilities, but drive them. But all other colleagues will help him [her] of course."(G4/PO)

In the case of deadlines and underestimated work effort, which are basically related to time pressure, the common mechanism between studied agile ISD is again searching for and finding someone who has the skill and capacity to do the task. Also, the team needs prioritization to omit some of the tasks and perform the highly prioritized tasks.

"If we have underestimated work effort, we have to do more or there is something open which we did not expect. Then we always look if someone has still capacity or skill. So for example if someone else was faster in our team, he can take over or take some responsibility."(G3/Dev(QE))

"Obviously the first priority would be to get the work done, and that really happens by the team coming together and sharing the workload to make sure it gets done and obviously we keep that in mind when we go into the next task to make sure that doesn't happen again. So either we reduce the workload accordingly, like let's say taking the important task so that it gets completed on time." (I4/SM)

Table 7 lists practices which occur during resource uncertainty to leverage diffusion and osmosis and overcome the tension.

Table 7. Practices to leverage information diffusion and osmosis during resource uncertainty

Leadership	**Practices**
Administrative	-Encourage multi-functionality among team members through agile practices -Implement practices to backup skills -Endorse knowledge transfer sessions -Endorse mentorship -Endorse documentation -Assign slack time and free Fridays -Recognize portfolio prioritization -Inform the upper level about the interruption
Enabling	-Compensate for the sense of missing knowledge or information -Bring the sense of shared identity for new members -Make sense of knowledge transfer sessions

	-Provide knowledge transfer sessions -Make sense of multifunctionality -Make sense of documentation -Consider buffering for task effort estimation
Emergent	-Provide the need for learning -Set the aspiration to learn from mistakes -Monitor implementation of lesson learned derived from retrospective and review meetings

5.2 Adaptive Outcomes vs. Agility

The findings show that in a highly knowledge-based area of agile ISD, in which tasks need a high level of professional and technical expertise, as well as a high level of experience, the mechanisms of self-organization in agile ISD center mainly on searching for knowledge, locating the source of knowledge, and maintaining knowledge or information. During self-organization the development of "shared mental models" (Dionne, Sayama, Hao, & Bush, 2010) are faster and the sense of "ownership" (Maruping, Zhang, & Venkatesh, 2009) within team members is promoted. Although Scrum imposes a structured way of working, during any kind of tension the entire agile ISD team or a sub-team will bypass structures and roles and will try to handle the situation through diffusion and osmosis mechanisms. Moreover, and despite the highly technical environment, the agile ISD team still needs to make sense of doing the tasks and be confident of having enough expertise to survive the difficult situation. This would be possible through appropriate coordination of administrative and enabling leadership.

"Whatever stressful situation that you are in, there should always be people who are supporting you and saying that it can be done, you should not be worrying. First, that will be expected from basically at least co-developers and the other thing is that if there is an escalation from the customer then obviously the APO and the product manager and the line manager will be in this, probably they will also say it's okay. So that will help us a lot." (I3/SM)

However, surprisingly, case analysis revealed that during various tensions causing the agile ISD team to self-organize, adaptive leadership in fact occurs less than expected. I observed that the lessons learned from tensions are limited to some adjustment and op-

timization in Scrum processing. For example, customizing team meetings, learning about task sequences, deciding about using a specific source, etc. Agile ISD teams mainly focus on performing the tasks efficiently, within time, budget and the scope. In this study, shedding light on the patterns of self-organization during tensions leads us to question "adaptive outcomes" in agile ISD teams. In fact, Scrum has been criticized by practitioners for not being a platform for innovation (e.g., Serrador, 2014). Even last year, the Scrum co-founder criticized the modern Scrum for too much focus on efficiency and too little on team creativity (Cohn, 2014). However, there are still very few studies that scrutinize the paradox of efficiency and innovation in Scrum teams (e.g., Hollis & Maiden, 2013). My observations in the studied company revealed that Scrum was developed not for innovation, but for rapid improvisation. As result, my inductive data analysis shows that in a sense Scrum is antithetical to innovation because it creates so many constraints on a developer's behavior.

"[Testing new ideas] is not really possible. We are overwhelmed with our own tasks for the sprint and so many customer messages. The workload is very high here." (G1/LM)

Through cross-case analysis I was able to categorize the teams into two general groups: "adaptive" and "non-adaptive". "Adaptive" teams are the Scrum teams in which there was at least one situation where a new idea or suggestion was recognized by the team, and made its way to implementation. I categorized an agile ISD team in the "adaptive" category depending on whether at least one of the interviewees on the same team was able to tell me about the "creativity" story. My categorization "non-adaptive" included those teams in which all the interviewees claimed not to remember any time that they come across or were allowed creativity.

The findings show that Scrum has positive effects when it separates the creative from the routine subtasks, allowing the creative tasks to be done outside of the Scrum; and has negative effects when it does not separate out creative from routine subtasks, and holds everyone to the tight standards of Scrum. For example, a PO in Brazil explained how his team was given the opportunity and extra time to do some brand new development for the region.

"So we just took it as an opportunity to do something valuable. So this is something we kept in mind. This helps to create mindsets: this is our opportunity; this is like our little baby. This is our time to do something different and very nice with innovation and new technology and I think lot of value for our region." (B3/PO)

Moreover, in adaptive agile ISD teams, agile ISD leadership specifies a backlog item for an innovative idea or testing assumptions.

"If somebody has new idea he [she] brings it in a retrospective. Then if the team agrees that it is a good idea we will formulate it in a backlog item. Then the person who proposed this idea will be the owner of the backlog and anybody interested will help [implement the idea]." (G3/APO(LM))

6 Conclusion and Contributions

My case study of twelve agile ISD teams revealed that agile ISD teams face three main tensions that bring the team into disequilibrium. To reduce or balance disequilibrium, agile ISD teams self-organize themselves through two sequential mechanisms: *information/knowledge diffusion* and *osmosis*. During these two mechanisms, emergent leaders are highly expert and experienced members or groups of members. This means that during self-organization, leadership responsibilities will be shifted to a group of individuals whose expertise is most relevant to the given problem (Friedrich, Vessey, Schuelke, Ruark, & Mumford, 2009). However, the findings revealed that during diffusion and osmosis the "emergent leadership" is *not* an adaptive leadership in the sense that adaptive leadership is a facilitator or producer of adaptive outcomes. In Scrum, the outcomes are pre-defined backlog items including tasks or customer requirements. Subsequently, the observations show that the outcomes of emergent leadership are usually technical solutions for the requirement or task. Information/knowledge diffusion and osmosis are patterns through which an agile ISD team leverages to adapt itself to the tension. Therefore, these mechanisms are inherent in team adaptability and not adaptive outcomes. In this study I also elaborated on several practices of administrative and enabling leadership during times of tension.

I believe that considering an agile ISD team as a unit of analysis for CLT, through an embedded case study design, opens up new horizons for within-case and cross-case

analysis of CAS contexts. Therefore, this study provides a fertile opportunity for the empirical study of CAS. This study contributes to research on CLT and consequently on complexity leadership in two ways: first, my findings highlight that in a highly knowledge-based and knowledge-dependent context, leadership is extensively influenced by sources of information or knowledge. As scholars have discussed, the richest or the most knowledgeable sources within a system will turn to emergent leaders (Friedrich et al., 2009; Majchrzak, Jarvenpaa, & Hollingshead, 2007). These emergent leaders will help the team to return to equilibrium. During the processes of coming back to equilibrium, many enabling and administrative leadership practices might occur. However, findings challenge the occurrence of the adaptive leadership element of CLT during tension, despite highly active enabling leadership. Second, the findings highlight that agile ISD teams such as CAS are self-organizing and are able to respond to the tension; yet the outcomes for such teams are pre-defined and tasks are highly granular. In such circumstances the response to uncertainty and tension will only be limited to problem solving and optimization of the processes to lower the pressure and to free resources such as time and expertise. Further research could draw on the nature of the tasks each agile team should perform, in order to trace adaptive outcomes through self-organization during tension.

My findings also contribute to ISD research. First, the findings highlight different practices on administrative and enabling leadership during tension. This enables the ISD research to not only focus on the adaptive nature of leadership in agile ISD teams, but also to shed light on administrative leadership, apart from the administrative roles and settings of agile ISD approaches. Second, the findings inform ISD leadership research to go beyond the individual roles of leaders in ISD and to focus on mechanisms that lead the team during different conditions. Overall, my findings contribute to the question of *whether CAS as self-organizing systems are adaptive*; and *whether this adaptability only involves the system adaptability to respond to the change, or it involves to adaptive outcomes*. This research suggests that to study the outcomes of complexity leadership the constraints of the context should be taken into account (e.g., Scrum in my study).

My findings also have several implications for practitioners: first, a detailed list of leadership practices is offered to help an agile ISD recover its equilibrium and overcome

typical ISD tensions. Second, the patterns of self-organization bring awareness to managers to better understand and compose their teams in a way that their agile teams react more efficiently to a tension. Third, the findings highlight that in order for adaptive outcomes to happen, enabling leadership is involved by inserting adaptive tension; administrative leadership is involved by loosening Scrum structures through defining adaptive backlogs. This awareness has made agile ISD advocates re-think Scrum structures and consider the role of enabling leadership for adaptive outcomes.

I also suggest that the following limitations need to be taken into account: first, I collected data from a single large multi-national software company to control for organizational culture and structures. However, further studies are needed to conduct similar studies in small and medium size enterprises (SMEs) or start-up companies to see whether different organizational culture and structures influence complexity leadership. Second, I only interviewed a few key roles per team. Covering all team members for interview might have enabled me to discover more leadership practices and might have opened up new perspectives of team adaptability. Third, I interviewed team members in three different countries and in the findings did not control for cultural differences. Further consideration of cultural differences is believed to be useful.

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Chapter 4

SOCIAL CAPITAL AND ADAPTIVE OUTCOMES IN AGILE INFORMATION SYSTEMS DEVELOPMENT TEAMS

Gholami, B. (2015). Social Capital and Adaptive Outcomes in Agile Information Systems Development Teams. *Information Systems Journal* (to be submitted).

Abstract. *Agile Information Systems Development (ISD) teams are social networks that interact intensively. They are designed to rapidly respond and fit to occurring change. However, after a decade of implementing agile practices, firms have begun to realize that agile ISD teams are not productive of adaptive outcomes. Agile ISD teams are criticized for focusing too much on efficiency and too little on team creativity. On the other hand, despite intensive discussions on the social and adaptive nature of agile ISD teams, there is still a lack of relevant and rigorous research examining agile ISD teams from the social rather than human perspective. Therefore, this study adopts an interpretive case study design and uses social capital theory as a lens through which to address how social capital develops in agile ISD teams, and how social capital development leads to adaptive outcomes in agile ISD teams.*

Keywords: *Social capital, Agile Information Systems Development (ISD), Adaptive outcome, Leadership development*

1 Introduction

For organizations, leadership is one of the imperatives of adaptive outcomes such as learning and innovation (Edmondson, Dillon, & Roloff, 2007; Gong, Huang, & Farh, 2009; Gumusluoglu & Ilsev, 2009; Han, Han, & Brass, 2014; Hazy & Uhl-Bien, 2013; Hemlin, Allwood, Martin, & Mumford, 2014). The impact of leadership on adaptive outcomes has been long studied by researchers. Whereas research has traditionally focused on the human capital of individuals (knowledge, skills, and abilities) for adaptive outcomes, recent research has turned to the social aspects of adaptive outcomes (e.g., Amabile, 2012; Fleming et al., 2007; Zhou et al., 2009). These researchers have argued that the creation of diverse and non-redundant ideas requires a focus on the social networks or social capital of individuals (Han et al., 2014).

Leadership is now a "social capital that collects around certain individuals" (Balkundi & Kilduff, 2006, p. 421). For leadership researchers, social capital has been regarded as one of the key factors of leadership development (Day, 2000). Social network theory can be an alternative way of understanding leadership effectiveness (Balkundi & Kilduff, 2006). *Leader* development is concerned with developing human capital. Human capital focuses on the individually-based knowledge, skills and abilities associated with the role of leader (Day, 2000). Conversely, *leadership* development is concerned with developing social capital (Day, Fleenor, Atwater, Sturm, & McKee, 2014). The principal components of social capital are the "(1) social network of individuals who exchange reciprocal cooperation and build collective resources, and (2) individual gains in personal resources by taking advantage of social networks" (Horiuchi, Kanazawa, Suzuki, & Takikawa, 2013, p. 4). Generally, three dimensions of social capital have been extensively analyzed in previous research: structural, relational, and cognitive (e.g., Chang & Chuang, 2011; Chiu, Hsu, & Wang, 2006; Moran, 2005; Nahapiet & Ghoshal, 1998; Parra-Requena, Rodrigo-Alarcón, & Garcia-Villaverde, 2013; Tsai, 2000). The structural dimension of social capital relates to an individual's ability to make weak and strong ties to others within a system (Nahapiet & Ghoshal, 1998). The relational dimension focuses on the characteristic of the connection between individuals. This is best characterized through trust and trustworthiness (Day, 2000). The cognitive dimension focuses on the shared meaning and understanding that individuals or groups have with one another. The cognitive dimension refers to those resources provid-

ing “shared representations, and systems of meaning among parties” (Nahapiet and Ghoshal 1998 p. 244).

On the other hand, agile methods explicitly integrate behavioral and social concerns into ISD (Whitworth & Biddle, 2007). Placing focus on human and social factors is important for the success of an agile initiative (Dybå & Dingsøyr, 2008). Agile ISD emphasizes self-organizing teams and empowered individuals in order to more effectively produce software (Highsmith, 2010). Agile ISD teams are essential social networks that interact intensively (Boehm & Turner, 2004). Agile ISD puts a stronger emphasis on people who require a higher degree of human communication and social interactions (Vidgen & Wang, 2009). However, agile ISD platforms such as scrum have been criticized by practitioners for not being a platform for adaptive outcomes (Cohn, 2014; Serrador, 2014). Therefore, considering the complex social and adaptive nature of agile ISD teams, the importance of leadership, and paradoxical outcomes of efficiency and adaptivity in agile ISD teams, there are several reasons why an in-depth study of adaptive outcomes and leadership and social capital development in agile ISD is believed to make major contributions.

First, agile ISD teams are dynamic social networks, and to study adaptive outcomes in these teams the social network of people should be considered. However, as mentioned, studies on adaptive outcomes in teams focus mainly on human capital and less on social capital. Second, in comparison with more than a century’s worth of research on traditional leadership theory, there is still a short history of rigorous research on the topic of leadership and social capital development (Day et al., 2014). I believe that studying social capital development in agile ISD teams will support understanding of leadership development in these teams, which are by nature self-organizing. Third, as Obstfeld (2005) argues, although bridging social capital may lead to creative ideas, it is the bonding social capital of connected groups that provides the ease of coordination necessary to implement innovative ideas and adaptive outcomes in organizations. Studying how agile ISD teams bridge and bond social resources seems essential for understanding paradoxical concepts of adaptivity and efficiency in agile ISD teams. Fourth, scholars need to consider how social capital and leadership processes change and evolve as they are influenced by *context* (Day, 2000; Dinh et al., 2014; Hazy & Uhl-Bien, 2013). The social nature of agile ISD teams creates a proper context in which to study social capital

and in turn leadership development. Therefore, the purpose of this study is to use social capital theory to develop an empirically based understanding of *how social capital develops in agile ISD teams, and how social capital development leads to adaptive outcomes in agile ISD teams.* The study is a multiple embedded case study design and adopts an interpretive stance in a multinational software company. The remainder of this research is organized as follows: first, to avoid the risk of biasing by theory (Walsham, 1995), I only briefly review social capital theory and I justify why I have used this theory to study agile ISD teams. I use social capital theory to guide the data collection process, and to develop coding outlines for data analysis (Suprateek Sarker, Xiao, & Beaulieu, 2013). Furthermore, I elaborate more on the concept of adaptive outcomes in agile ISD teams using the double-loop learning theory. In line with context-specific research (Hong, Chan, Thong, Chasalow, & Dhillon, 2013), I present the research context of the studied agile ISD and carefully explain the research context in the research design section. Next, I describe the empirical findings and discuss two different configurations of agile ISD teams based of the social capital assessment. Finally, I conclude with contributions, limitations, and further opportunities for research.

2 Theoretical Background

2.1 Social Capital and Leadership Development

Social capital is an interdisciplinary concept with which to address collective behaviors and social interactions within a system of people. It involves accessing and making use of resources which are embedded in social networks to produce expected returns (Lin, Cook, & Burt, 2001). Social capital is a key enabler of knowledge sharing, learning, and innovation as fundamentals of competitive advantage for organizations (Argote & Ingram, 2000; Brachos, Kostopoulos, Soderquist, & Prastacos, 2007; Nicolas, 2004).

Different disciplines have conceptualized social capital with various perspectives and definitions, and there are still discussions on the one- or multidimensional character of the social capital construct (Parra-Requena et al., 2013). For example, Flap and Völker (2001) conceptualize social capital as one dimension which is a network structure and includes the position of an actor in the network. Moran (2005) conceptualizes social capital as a structural dimension of direct ties and the relational dimension of relational trust between ties. Nahapiet & Ghoshal (1998) adopt a three-dimensional perspective of

social capital consisting of structural, relational, and cognitive dimensions. These three dimensions have been extensively analyzed in recent research on social capital (e.g., Chang & Chuang 2011; Chiu et al. 2006; Parra-Requena et al. 2013). The three-dimensional perspective of social capital is more appropriate for this research since it encompasses not only the overall patterns of connections (structural) in an agile ISD team, but also the kind of personal relationships developed through a history of interactions (relational) (Granovetter, 1992), as well as the underlying shared representation and collective meaning (cognitive) within a network. Therefore, because of its comprehensiveness, this study adopts the three-dimensional perspective of social capital. The three-dimensional perspectives of social capital are significantly related to each other (Nahapiet & Ghoshal, 1998). For example, Westerlund & Svahn (2008) discuss how the relational dimension of social capital reflects the impacts of structural and cognitive dimensions:

The structural dimension focuses on resources related to an individual's ability to make weak and strong ties to others within a system. This dimension focuses on the advantages derived from the configuration of an actor's network (Nahapiet & Ghoshal, 1998). That is, who an individual reaches and how s/he reaches them (Burt, 2009).

The relational dimension focuses on the resources concerning the nature and quality of connections between individuals (Chang & Chuang, 2011; Moran, 2005). This is best characterized through trust and trustworthiness, where trust is an attribute of a relationship and trustworthiness is a quality of an individual (Day, 2000; Tsai, 2000).

The cognitive dimension focuses on the resources related to shared meaning and understanding that individuals or groups have with one another (Westerlund & Svahn, 2008). The cognitive dimension refers to those resources providing shared representations, and systems of meaning among network members (Nahapiet & Ghoshal, 1998). Shared goals represent the degree to which "network members share a common understanding and approach toward tasks and the outcomes of the network" (Parra-Requena et al., 2013, p. 71).

Moreover, from the leadership research standpoint, the focus in leadership development shifts towards the development of social capital instead of human capital (Clarke, 2013;

Day et al., 2014; McCallum & O'Connell, 2009). Leadership is now inherent in relationships, and no longer exists in one individual. From this perspective, many researchers have identified the importance of both intrapersonal and interpersonal skill development, for leaders as well as followers, as being a key focus for leadership development through building social capital (Day, 2000; McCallum & O'Connell, 2009). Building social capital expands an organization's capacity to establish leadership tasks needed for collective work (McCauley & Velsor, 2004).

2.2 Social Characteristics of Agile ISD Teams

ISD in general is a social process (Vidgen & Wang, 2009). ISD depends on the performance of teams, which is further determined by culture, mindsets and human interaction (Moe, Dingsøyr, & Dybå, 2010). Agile ISD emphasizes people and interactions over process and tools (Fowler & Highsmith, 2001). Therefore, agile ISD approaches rely on socialization through communication and collaboration to access and share tacit knowledge within a team by suggesting information sharing strategies and use of communication tools (Abrahamsson, 2002; Nerur, Mahapatra, & Mangalaraj, 2005). Placing focus on human and social factors is important for the success of an agile initiative (Dybå & Dingsøyr, 2008). In agile ISD teams social controls have more influence on team practices than the suggested methodologies (Nandhakumar & Avison, 1999). Team orientation, leadership, coordination, and highly specialized skills, as well as building up trust and common mental models all determine team effectiveness in agile ISD teams (Moe et al., 2010). Table 1 is an example of different social aspects of agile ISD emphasized by researchers. The aspects mentioned in Table 1 are overlapping and not distinct because of the social and interrelatedness of human aspects of agile ISD.

2.3 Adaptive Outcomes

Sterman (2000) discusses that in interactive systems learning arises from agents' interaction with one another, and from feedback loops. Basically, in socially interactive and interdependent networks, dynamic patterns of behavior produce outcomes. In these networks, adaptive ideas emerge in the contexts such as: "networks of interaction, patterns of tension, interdependent relationships, rules of action, direct and indirect feedback loops, and rapidly changing environmental demands" (Uhl-Bien, Marion, & McKelvey,

2007, p. 307). In the systems where social interactions are intensively high, "creativity and learning occur when the system forms a previously unknown solution to a problem or creates a new, unanticipated outcome" (Uhl-Bien et al., 2007, p. 303). In self-organizing systems, reactions to any situation cannot be anticipated. The system always tends to evolve towards a state of equilibrium to reduce uncertainty where the different parts of the system are mutually adapted (Heylighen, 2001). This process produces *adaptive outcomes*. An example is the rejection of original ideas and the creation of a totally new idea. It is a process of seeing beyond original norms or assumptions to something not constrained by those norms or assumptions.

Table 1. Examples of the social aspects of agile ISD

Aspects	**Explanation**	**Example reference(s)**
Team composition	Teams are cross-functional. Emphasis on multiskilling and multifunctionality of team members.	(Cockburn & Highsmith, 2001; Vidgen & Wang, 2009)
Team size	Functions best with team size of 10 people or less.	(Cockburn & Highsmith, 2001)
Self-organization	Autonomy, team orientation, shared leadership, redundancy, and learning.	(Moe, Dingsøyr, & Røyrvik, 2009)
Training	Informal sessions, flexible, timesaving, requires good interpersonal relationship and mutual trust.	(Chau, Maurer, & Melnik, 2003; L. Williams & Kessler, 2002)
Continuous learning	Frequent retrospectives, responsive to problems and risks, inner-team.	(Chau et al., 2003; Vidgen & Wang, 2009)
Team competence	Self-organizing, flexible, adaptive to unexpected challenges, cohesive, information visualization and transparency.	(Cockburn & Highsmith, 2001; Whitworth & Biddle, 2007)
Motivation	Agile ISD motivates to voluntarily task selection; sense of belonging and involvement; recognition, collaboration, trust and respect; task identification, visibility and transparency.	(Beecham, Sharp, Baddoo, Hall, & Robinson, 2007)

One of the examples of processes through which adaptive outcomes are likely to be generated is “double-loop learning” (Argyris, 1976, 2002). In double-loop (Figure 1) learning the goal, values, and variables may be questioned, scrutinized, or even rejected and reformulated. Such learning may bring about a change in the way in which strategies and consequences are framed (Argyris, 1976) in a system. Another example is the processes of generating ideas, selecting ideas and implementing those ideas which are needed for turning creativity into innovation (Somech & Drach-Zahavy, 2013), or for turning fine-grain interactions to coarse-grain properties (Hazy & Uhl-Bien, 2013). Somech & Drach-Zahavy (2013) find that team creativity is positively associated with innovation implementation only in a highly innovative climate (vision, participative safety, task orientation, and support for innovation). Also, Hazy & Uhl-Bien (2013) discuss that adaptive outcomes occur when fine-grain interactions facilitate the emergence of coarse-grain properties. Fine-grain interactions in the system include day-to-day interactions, relationships, and transactions of agents. Coarse-grain properties are accepted rules, norms, obligations or identifications which can be observed either locally as daily routines or organizationally as policies and strategies (Hazy & Uhl-Bien, 2013).

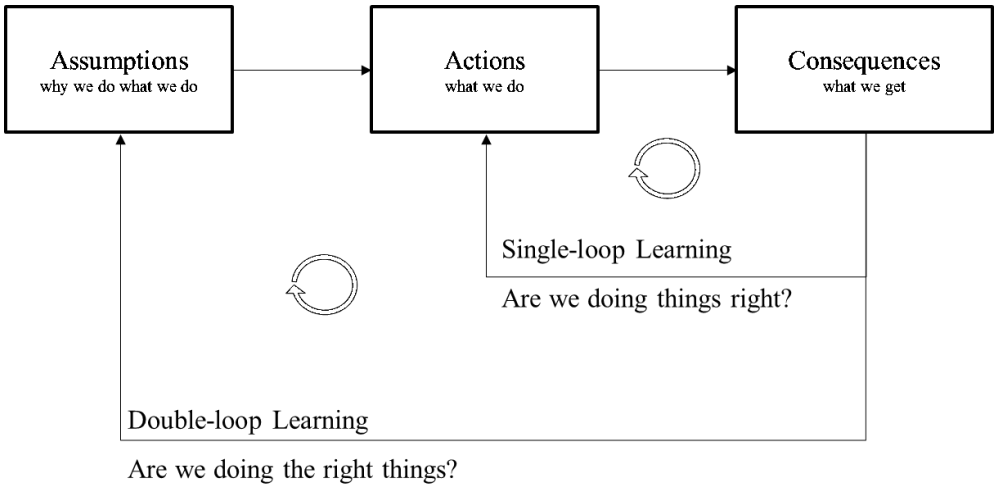


Figure 1. Double-loop learning (Adapted: (Argyris, 2002))

In sum, adaptive outcomes are likely to take place when underlying assumptions, norms and regulations, or strategies in a social interactive system are questioned, changed, or modified. This study traces any indication of adaptive outcomes in the studied agile ISD teams during decision-making processes and uncertain situations.

3 Research Design

3.1 Research Methodology

Agile ISD deals with the social and relational network of people (Vidgen & Wang, 2009). The interactions between people in agile ISD teams are dynamic, subjective, and complex. This study aims at understanding social capital and leadership development which are grounded in the dynamic and subjective interplay between the social network of people in agile ISD teams, and thus the interpretive case study (Walsham, 1995, 2006) is an appropriate research methodology for such context. To answer the *how* question of the research question I follow the interpretive guidelines (Saonee Sarker & Sarker, 2009, pp. 445–446) for a multiple embedded case study (Yin, 2009) in a multinational software company. This provides an in-depth understanding of social capital and leadership development based on rich empirical evidence (Yin, 2009). The software company has implemented agile practices for six years in order to be responsive to change and the competitive environment of software development. The company values agile practices and encourages empowered ISD teams. The single company was selected to control for factors such as organizational culture, leadership and management structure, as well as the agile methodology adopted by the company.

3.2 Research Context

I chose agile ISD as a context of this study. As Hong et al. (2013) have discussed, context has a high value in theory development in Information Systems (IS) research. As mentioned, agile ISD focuses on the social aspects of IS development and emphasizes empowered and self-organized teams. The concept of agility was introduced to ISD to enable IS projects to respond quickly to change. I use what is Hong et al. (2013) call "cross-context theory replication". I replicate the social capital theoretical model in the context of agile ISD and then consolidate the findings into a context contingent theory (Hong et al., 2013).

I conducted the study in a multinational software company. Agile ISD methodology had been introduced to the company six years beforehand. The company's product portfolio varies from Database Management System, ERP, and CRM software packages through to corporate portal and business intelligence platforms. This study was conducted in a

division of the company (GlobDiv) that is responsible for customizing software packages according to the rules and regulations of different countries. GlobDiv is considered to be the most international division of the company and consists of scrum teams working for a specific area and region. Each region has Area Product Owner (APO) who is responsible for a specific geographical area, and for the scrum teams working for that area. Each scrum team has a Product Owner (PO) who is responsible for translating the business context into software requirements. The PO also ensures that the team delivers value to business. Each scrum team also has a Scrum Master (SM) facilitating the scrum team's daily work, leveraging collaboration and teamwork, and protecting the team from external interferences and operational impediments. There is also a Line Manager (LM) for each scrum team. The LM is responsible for scrum teams having the same product scope and ensuring alignment of the team goal with company strategy. The LM is also responsible for performance assessment of each scrum team and the team members. In GlobDiv there is also a role of Local Product Managers (LPM). The LPM is in contact with the PO and the customer. The LPM is responsible for clarifying and bringing customer requirements to the scrum team. The LPM is in direct contact with the PO. LPMs are usually native speakers of the language of the country for which the software is being customized. LPMs are also familiar with the country's laws, so they can clarify changes for the PO and the scrum team. Figure 2 depicts the team structure in GlobDiv.

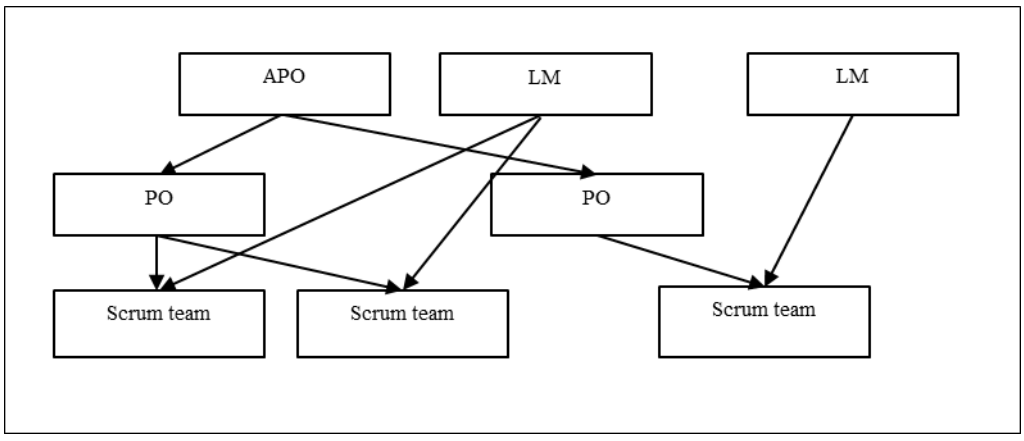


Figure 2. Team structure in GlobDiv

The company produces general software packages and the scrum teams in GlobDiv have to customize the package for each country. Thus, the scrum teams in GlobDiv work closely with core teams. The core team has already developed the general software

package, and scrum teams responsible for the software need to contact the core team to understand the software architecture, codes, and functionalities of the general software package so they can customize it for the specific county. There are also some other roles in a scrum team, such as Architect and Quality Engineer. Scrum teams in GlobDiv are responsible for both development and maintenance. As indicated by the managers of the company, the task in the GlobDiv is vital for the company and is changing fast. Customers in different countries need to apply regulation changes in the software package as soon as the regulation is announced by the respective government. The scrum teams need to respond very fast to the changes and clarify government laws and customer needs very quickly. Responding rapidly and effectively to the change causes scrum teams to go thorough different social interactions and complex relational interplays. This makes GlobDiv as a proper context in which to study social capital during change and to assess adaptive outcomes.

3.3 Data Collection

I was first introduced to the GlobDiv by contacting the senior manager who was responsible for Delivery and Quality and Operations (DQO) team. This team consists of 17 members and four sub-teams. The sub-teams are responsible for maintenance, new development, quality standardization, and quality testing within GlobDiv. Accordingly, the DQO team was in contact with other scrum teams in different areas in the GlobDiv.

The manager of the DQO team has a weekly meeting with APOs of GlobDiv. The meeting is about exchanging news and challenges of the division pertaining to development, maintenance and scrum teams. I was introduced to APOs in one of the weekly meetings. Suitable responses were suggested by APOs. I interviewed the APO and the APO redirected me to the POs with whom they work. Each PO then introduced me the key team members able to provide me with an in-depth rich interview about teamwork during change and uncertain situations. I first observed a total of 20 meetings of DQO teams and the sub-teams' interactions with other scrum teams. With the help of the manager of the DQO team I then initiated the interviews. I also had access to other sources of data such as the corporate portal, wikis, and GlobDiv internal documents. I also attended weekly meetings of APOs and the DQO team manager. The initiation of the research in

GlobDiv through to the final interviews took place between November 2013 and August 2014.

Furthermore, I had been a part-time employee in the company since June 2011. During those four years of unique experience in the company I was directly involved in company projects. I also participated in company surveys and had formal and informal talks with many senior managers and ISD team members. As a field researcher, I gained close and intimate familiarity with company culture and climate and gained deep insights into the social aspect of agile ISD. After taking notes and writing memos, the semi-structured interview was designed. I used the "critical incidence" (Flanagan, 1954; Lipu, Williamson, & Lloyd, 2007) technique for this research. I asked my respondents to tell the story of critical situations during the team's work and in uncertain situations. The critical incidence approach has also been used by other IS researchers (e.g., Majchrzak, Beath, Lim, & Chin, 2005). The semi-structured interview lasted between 45 and 90 minutes. Interviews were recorded and transcribed. This research is embedded in a larger research program aiming at understanding and improving the human aspects of software development within software development teams, such as leadership and learning. The interview protocol was designed to cover two different research questions in light of different theoretical lenses. Table 2 shows the overview of data collection.

Table 2. Data collection overview

Location [a)]	Area A				Area B				Area C			
#APO Interviewed	2				1 (LM)				4			
Agile ISD team	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4
Roles Interviewed [b), c)]	PO, SM	PO, SM, Dev.	PO, SM(Dev), QE	Dev(QE), SM	LM, PO, Dev(QE)	LM, PO, Dev(QE)	PO, Dev(QE)	PO, Dev	PO, SM	PO(LM), Dev	PO, SM	PO, SM
#Interviewees in team	2	3	2	2	3	3	2	2	2	2	2	2

[a)] Roles are as follows: APO: Area Product Owner, LM: Line Manager, LPM: Local Product Manager, PO: Product Owner, SM: Scrum Master, Dev: Developer, Arch: Architect, QE: Quality Engineer [b)] Some interviewees have more than one role [c)] For quotation I use an ID for the interviewee based on the team and the role. For example, B3/SM(Dev) means the Scrum Master (who also has the role of Developer) from team 3 in Area B.

3.4 Data Analysis

The process of data analysis involves both inductive (Walsham, 2006) and abductive (Alvesson & Kärreman, 2007) approaches. This is consistent with the notion of "constant comparison" (Saonee Sarker & Sarker, 2009). As explained in the research context session, in line with "cross-context theory replication" (Hong et al., 2013), the abductive approach involves applying a general theory, refining the general theory in light of the specific research context and empirical phenomenon, and articulating a new interpretive theory that explains the empirical phenomenon in the specific research domain (Alvesson & Kärreman, 2007).

I considered an agile ISD team as the unit of analysis. Data analysis occurred iteratively. As field notes and interviews were transcribed, they were coded. Through this early analysis I formulated new questions for later interviews (Strong & Volkoff, 2010). I identified and refined concepts through a "constant comparison" approach to identify initial concepts, group similar concepts to form categories, and identify properties of the categories (Strauss & Corbin, 1990). For triangulation, I used different sources of data besides interviews. I used memos and notes during observations as well as the contents of internal wikis and documents. I had regular meetings with the manager of the DQO team and interviewed all members of the DQO team as well. The initial results of the research were presented to a large audience in the company, and concepts were checked and refined with two experienced scrum mentors as "informants" (Bygstad & Munkvold, 2011). In the next section I present the findings and reflect on the empirical data.

4 Empirical Findings

4.1 Uncertain Situations in Agile ISD Teams

In this study three main uncertain situations were found requiring the response of an agile ISD team: *requirement uncertainty, task uncertainty, and resource uncertainty.*

First, requirement uncertainty is the most common uncertainty in ISD (Browne & Ramesh, 2002). Williams (2005) indicated that agile practices are targeted towards software projects where uncertainties, changes, and ill-defined requirements are com-

monly present. Requirement clarification in agile teams is more dynamic and adaptive and does not follow formalized processes (Cao & Ramesh, 2008). Therefore, research on agile development has identified a number of situational uncertainties, such as requirements uncertainty (Maruping, Zhang, & Venkatesh, 2009). Consistent with the taxonomy of Dönmez & Grote (2013), in this study uncertainties regarding requirements can occur, such as a lack of details about functionality or insufficient understanding of business context, ambiguous information, and unexpected changes. For example, C1/SM explained, *"This happens all the time and it just depends [on] the job actually, I mean […] first of all you get a high level document, which will describe the business requirement [and] the business context, and for sure it will be lacking in details. [Then], some questions will follow, like: [does] the software do this? Is this acceptable for the customer? If yes, great! If not, why not, and what needs to change?"* Normally, it is the responsibility of the LPM to bring and clarify business requirements for the scrum team. The LPM has to contact the PO and clarify the requirement in a document; the PO then will translate the business requirement into a software requirement and defines the product backlog. This process of transferring, clarifying, and translating the customer requirement is usually a challenging process for the studied agile ISD teams. This is because the LPMs are located in the country for which the software package should change, and the clarification process needs more time and communication. For instance, B3/PO stated, *"We present a possible solution for the product and then the team evaluates it and gives opinions. Then we present it to our local product manager, […], and I would say this is probably the worst part in the decision making, because we are [connecting] remotely. They are located [in the destination country], and sometimes they are very unclear, or our customers need [to contact them more often] to talk to them but they (LPMs) only talk two or three times during this decision making period."*

Second, task uncertainty occurs when there are unexpected dependencies between the tasks. This happens when there are situations that different software functionalities should perform sequentially (Espinosa, Lerch, & Kraut, 2004). There are also times that the task is not routine and needs novel solutions (Edmondson, 1999). In the studied teams, as mentioned, there is a task dependency between the scrum team, which is responsible for localizing the software package for a specific country, and the core team, which is responsible for developing the general software package. The scrum teams in

GlobDiv should clarify requirement changes, and check the changes with the core team. Changing or adding a functionality or component in the software package requires a confirmation from the core team. As B2/Dev(QE) mentioned, *"Sometimes, there are certain situations we have to align with the core team. […] So, if I do my changes I have to take the permission of the core [team]."* This process does not always work well in GlobDiv.

"*So I think this happens very often [and] it gets more complicated than we think. […] you know in software everything is networked, so if you change A then B then C then D and E need to change... these dependencies have maybe not been so clear from the beginning, so [the process] can take longer." (B3/APO(LM))*

Third, this study also identified resource uncertainty. Resources in this study include anything that can be used for ISD processes such as human resources, time and budget, and technology. In the findings I recognized three categories of resources that will cause uncertainty for scrum teams in GlobDiv. These three categories are: human, time, and equipment.

In terms of human resources, in agile ISD, team members need to be multiskilling and multifunctional (Moe et al., 2010). However, the task of scrum teams in GlobDiv is sometimes very complicated, so that absence of an expert, or integrating a new team member may cause impediments. Moreover, the self-organizing nature of agile teams in GlobDiv and the multifunctionality of team members sometimes cause overlapping or unclear roles or responsibility.

"Maybe the entire team has some basic knowledge about it but not in detail. So we try all together [to go thorough] the documents which were collected, also sometimes we hope that this topic is never coming up again." (B4/PO)

Additionally, time is a valuable and scarce resource for Scrum teams in GlobDiv. According to the findings, time uncertainty mostly indicates underestimated work efforts and short deadlines. Basically, scrum teams in GlobDiv need to respond to customer requirements as fast as possible because government regulations need to be implemented as soon as they are approved or changed. This causes the teams to have short development cycles and deadline pressures: *"We also have really short cycles, just only three*

development sprints, so we really don't have time. […] you always have to be [on] time […] so we have to act really agile." (B2/PO)

Also, the findings show that in GlobDiv scrum teams work on integrated ERP platforms. Scrum teams depend heavily on this platform and if the system is down, the teams will be paralyzed. "*If we have systems down or other interruptions, we cannot do anything, so we are looking for things we want[ed] to do but never had time for them."* B3/Dev(QE)

Considering the uncertain situations in GlobDiv and using the social capital framework, in the next section I elaborate on the empirical findings to uncover how social capital, and in turn leadership, develop during uncertainty and change. I then explain two main social capital development configurations and discuss how these configurations will lead to adaptive outcomes.

4.2 Social Capital Development during Uncertain Situations in GlobDiv

Using the abductive approach for within-team analysis, this section describes the findings through the lens of social capital dimensions.

4.2.1 Structural Dimension

Data analysis shows that the most expert or experienced member in the team is the tie that other team members rely on during uncertain situations. For example, during requirement uncertainty, the LPM is supposed to understand and clarify the customer requirement or regulation change, while the PO should transfer the LPM's message to the scrum team. Therefore, the primary configuration of the network in times of requirement change will be LPM<->PO<->scrum team. However, when the LPM fails to bring sufficient information to the scrum team through the PO, the PO her/himself will try to contact customers or translate regulations.

"Because I speak the language [of the county we localize the software for], I myself can read and translate the regulation changes for my team. This is a unique situation in our team and we do not rely much on the local product manager."(B3/PO)

Data also shows that in the case of the pressure being higher than usual, team members bypass the PO and the LPM and connect to the customer individually. However, this requires the PO of the team to provide access to customers and empower the team members to seek and clarify information. The scrum teams in GlobDiv also should consult with the core team and the software architect about the feasibility of requirement changes.

"I personally contact the product manager directly via phone or email. I have direct contact with them. That works fine. I know some teams where the team members only have to ask the product owner to talk to the product manager, but I personally don't like this approach." (A2/Dev)

In the case of uncertain task sequences and dependencies and also estimation of work effort, the role of experience is dominant. In the teams studied, task sequences and dependencies can be predicted and estimated by experience, either by the whole team or by an experienced PO, Architect, or LM.

"You know in software everything is networked, so if you change A then B then C then D and E need to change... and these dependencies have maybe not been so clear from the beginning, so that this can take longer. I think for that we need experience to build buffers in our estimation not to overcommit ourselves. Very experiences teams, for example, they try to not overcommit, to always commit to a little bit less that they can deliver… As a baker knows how much bread to bake for a day, an experienced software team knows how many customer messages have to get solved in a day and how to commit to tasks." (B3/APO(LM))

When integrating a new team member, an expert will be assigned as a mentor. Of course the entire team will also support the new team member to smooth the integration. In addition, compensating for an absence needs expertise and experience. Scrum teams in GlobDiv usually have a backup person for different tasks. However, the complexity of some tasks causes some teams to rely heavily on only one expert tie in an area.

"If this person leaves, I also need another one or at least two persons, because he was such an expert and then we have to look for solutions in that area." (B3/PO)

Generally, teams in GlobDiv try to locate and refer to experts beyond the boundaries of the teams. This helps the teams expand their network and solve technical problems even when the team has no expert on the topic.

"We have a Wiki page for the team, for our area. There, we find the local experts. We always have certain topics and certain local experts. So we check the list in the Wiki and we contact them."(B2/Dev(QE))

4.2.2 Cognitive Dimension

The findings show that a shared vision and a shared goal are among the imperatives of agile ISD teams in GlobDiv. Basically, what encourages agile ISD teams to respond quickly to the change is the shared understanding of what the team pursues. There are two important factors in helping agile ISD teams to create a shared vision and goal. First, some of the customers dealing with GlobDiv are the company's most important customers. Second, the tasks in GlobDiv mostly concern the country's laws and regulations. The nature of the tasks makes them important to consider and necessitates a fast reaction to any changes that occur. These reasons constitute the underlining meaningfulness of agile ISD teams in GlobDiv. However, during requirement change the scrum team does not always share the same language with the LPM or customers.

"So if we don´t do it the customer will get fees or things to pay by the tax authorities, by the social insurance, the health insurance and so on. If you don´t pay attention [to customer needs] and you have errors, the companies and the employers are punished by the government. So our work is very important and [we] get the feedback [from customers on that]."(C4/PO)

In terms of task uncertainty, the findings reveal that task granularity presents a paradox for some teams. Agile methodology empowers team members to pick up the task depending on their desire and expertise; however, in GlobDiv some tasks are very complex to understand and work on. This causes the POs to increase task granularity as much as they can, so the scrum team shares the same understanding of the task. In this case, there is no need for all team members to understand the task. Shared understanding of the task will be encouraged among those team members who are involved with or responsible for the task. Therefore, the complexity of the task may divide the scrum

team into sub-teams. Nonetheless, sub-teams barely share the same understanding and vision. In some teams, daily scrum meetings were even omitted because of the belief that talking about the tasks of a sub-team is not interesting for other sub-teams in the same scrum team.

"We don't have one topic that everybody is working on, we have several small topics. […] we work for payroll, but within the payroll there are different and really separated topics. There is one topic which is for example, has to do something with ERP, [one topic has to do] something with tax, […] and those topics were too complex to have it for the entire team. So now we have sub-teams and we don't have a daily scrum anymore." (B4/Dev)

During times of deadline pressure, the sense of shared identity is also recognizable in the findings. Shared identity is a dynamic and emergent state which means the sense of belonging to the team (Hinds & Mortensen, 2005). In studied agile ISD teams, the sense of shared identity emerges when teams are monitored or assessed for their reaction to the change or their action during pressure to meet deadlines. Monitoring or assessing the teams is usually performed by formal leaders. Therefore, the sense of shared identity is usually injected into the team by the PO and the APO, or the LM. The findings also show that expert ties in the studied teams can promote shared identity within teams. As a consequence, if expert ties are absent within a team, the sense of shared identity and meaningfulness may be vulnerable.

"We had an expert in the team and everybody referred to him to see if we can do the task. When he left, I felt like the team was a bit demotivated and lost some confidence." (B3/PO)

4.2.3 Relational Dimension

The findings reveal that the most experienced and skillful people within an agile ISD team in GlobDiv are usually perceived as the most trustworthy ties within the studied teams. In times of decision making during uncertain situations, team members will rely on the leadership role or the experts.

"We have a few senior people in the team, so each person has kind of expertise in some areas, so we assess in which area we are facing this [uncertainty], and who is the best person who can [help us] get out of the situation. Then, that person takes the lead at this point of time, so this person then guides the rest of the people working so that they can overcome the situation the fastest way." (C1/PO)

Some teams try to set some rules to tackle requirement or task uncertainty. The findings show that the successful teams able to overcome the situation or lower the risk of uncertain situations were those which set rules and clarified them with all team members and other ties involved within the network of the team.

"We established our rules: we will start to work on a new topic only if the previous topics were done."(A3/SM(Dev))

As mentioned, teams in GlobDiv work for very important customers of the company. This creates some obligations for teams in GlobDiv. In some cases, certain agile ISD teams are directly monitored by top management. To reduce the pressure and help teams in such situations, all key people in the team try to set some rules or clarify the objectives.

"Every mandatory idea that is suggested, we just try to show which value it is adding to the customers and [to the company]. We create a rational discussion to convince and motivate people." (A3/QE)

Generally, agile ISD teams in GlobDiv customize the scrum according to their needs. Each team has its own customized sets of scrum meetings and artefacts. Also, there are different informal roles in some teams, which they define for their scrum settings. For example, to make sure all tasks are done, and that a mistake or error does not happen again, a team creates "audit groups". These audit groups consist of one or two persons who are expert in a field and aware of the task of the entire team, so they can check the status of tasks and make sure everything is progressing smoothly and review specific tasks and topics. In turn, the team omits retrospectives. Moreover, in some other teams there are so-called "critical thinkers". These are experts who question tasks and topics and persuade the team members to think critically, so the team can be more creative in problem solving and also become ready and equipped for unexpected situations.

"Everybody's role has the potential to be influential, I mean we're all empowered, as I say we all test each other by critical thinking and asking more questions, I don't say we test each other in a negative way, but sort of, you know, if I have a certain assumption, I want that assumption to be criticized and tested, so I mean it's actually a very influential role if somebody can do that for you." (C1/SM)

Applying an inductive approach for cross-team analysis, the next section elaborates on two different configurations of social capital in the studied agile ISD teams, and explains how adaptive outcomes are facilitated or inhibited in these two different team social capital configurations.

5 Discussions

Cross-team analysis shows that mostly, agile ISD teams are formed in two different configurations based on social capital dimensions: *collective* and *island*. These two forms of social capital in the studied agile ISD teams are rooted in two important factors: first is the level of experience and expertise of each team member as a network tie. This refers to multiskilling and multifunctionality of team members in an agile ISD team. Second is the complexity level of the team's task. This refers to routine tasks, like maintaining a software package, in comparison to novel tasks, such as developing a completely new software component. Also, in GlobDiv, task complexity refers to software architecture, the level of task dependencies, and complexity of software functionalities.

Furthermore, I categorize the teams' outcomes into two general groups: adaptive and non-adaptive. As discussed, I code adaptive outcomes as a new idea or suggestion that was recognized by the team, and made its way to implementation. In the non-adaptive outcomes categorization are technical and routine tasks that do not need any creativity or did not change team's operation. Following inductive analysis, I then take a deeper look into the two recognized social capital configurations (collective and island) regarding adaptive outcomes. Subsequently, findings reveal enablers and inhibitors of adaptive outcomes in both configurations of social capital in agile ISD teams. Thereupon, I elaborate more on *collective* and *island* configurations, and shed light on team outcomes within these two configurations. Table 3 illustrates social capital configurations of agile

ISD teams. The cells filled with X will be explained further while evaluating adaptive outcomes.

Table 3. Patterns of social capital in agile ISD teams

Task complexity / **Team members**	Low/Moderate	High
Homogenous	Collective	X
Heterogeneous	X	Island

5.1 Collective

Collective configuration indicates homogenous team members and low to moderate task complexity. Generally, although team members are able to perform different tasks and have a sense of ownership towards doing specific tasks, the entire team consists of more or less the same level of expertise and experience. The team remains homogenous as long as the team's task remains routine or has a moderate level of complexity. Each team member is responsible for a task and usually everybody knows who to refer to for specific topics. In GlobDiv, customers can send any kind of technical and software related issues to the corresponding agile ISD team through customer messages. In *collective* teams each team member knows which customer messages she/he is responsible for solving. Moreover, each team member has a backup person. Two team members, who are each other's backup, know about the details of each other's tasks and customer messages. For instance, observations show that to ensure a high degree of homogeneity, team members regularly rotate their roles and/or change their tasks: *"So it's encouraged that people regularly change the tasks that they tend to work on, so that everybody in the team gets a chance to develop an expertise in various areas."(C3/SM)*

Agile ISD teams with a *collective* configuration are the teams that are most passionate about agile principles. Knowledge and expertise are evenly distributed across team members. Scrum meetings are mostly set, and scrum roles are clearly defined and understood. Usually the PO is considered the leader of the team who is the most expert team member. Actively running scrum meetings enables *collective* teams to benefit from transparency. Team members can openly talk about their daily progress and issues during daily meetings. Also, retrospectives are essential meetings for *collective* teams to discuss lessons learned and define any backlog item to implement lessons learned. Fol-

lowing agile principles, *collective* teams are able to self-organize themselves during uncertain situations and benefit from shared leadership, rather than centralized management.

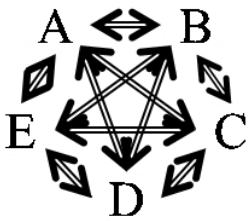
In self-organizing teams, leadership is shared (Uhl-Bien et al., 2007) and it is associated with people working together to accomplish shared work (Day, Gronn, & Salas, 2004). Thus, shared leadership is distributed within a team of individuals rather than localized in any one individual who serves in the role of supervisor (Pearce & Conger, 2003). Researchers argue that agile ISD teams are closely associated with shared leadership and discuss its appropriateness as well as implementation (e.g., Hewitt and Walz 2005; Karhatsu et al. 2010; Moe et al. 2010; Moe, Dingsyr, et al. 2009; Nerur et al. 2010). Although shared and distributed leadership are treated as synonyms in the literature (DeRue, 2011), the findings indicate that there is a difference between shared leadership and distributed leadership in the studied agile ISD teams.

Structural evaluations of the studied agile ISD teams reveal that although *collective* agile ISD teams benefit from self-organization and decentralized leadership, shared and distributed leadership should be distinguished for such teams. Following DeRue (2011), I discuss that there is a structural difference between shared and distributed leadership in *collective* teams. Figure 3 illustrates the structural dimension of social capital and leadership in *collective* agile ISD teams.

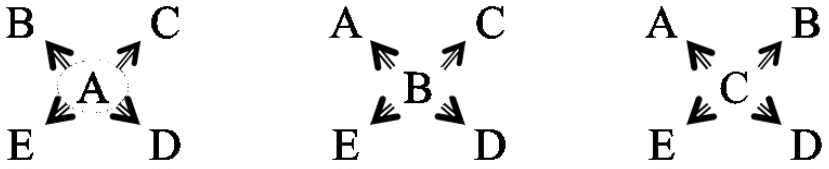
Figure 3a illustrates shared leadership in collective agile ISD teams. This structural pattern occurs when task complexity is low and every team member has the same role in unraveling uncertainty. This structural configuration does not depend on the situation. All team members relate closely to each other and the level of communication is the same among team members. For instance, the PO, as the most experienced person, acts like other team members; for example, by sitting in the same room with others, taking responsibility for selected backlog items and participating in scrum daily meetings. Shared leadership occurs in the absence of task priority, backlog items or customer messages. Even if there are some critical tasks to perform, all team members will be involved in solving the tasks. For example, the Scrum Master of the team A3 explains that: *"[…] we were able to solve all of those [customer] messages. We pulled everyone*

in, put the most critical messages on the board, and reworked them together; the entire team." (A3/SM(Dev))

Distributed leadership (Figure 3b), on the other hand, usually happens when performing a task needs more expertise. For example, during human resource uncertainty (Figure 3b, s1), when a new team member should be integrated into the team, a mentor will be assigned. The mentor is the most experienced and skillful person in the field. In this situation, the mentor takes the lead to unravel the uncertainty which integrating a new team member creates for the team. During other situations, for instance requirement change (Figure 3b, s2), a team member or groups of team members take the lead. Assigned leaders are the most experienced people, performing prioritized tasks or tackling the most urgent customer messages. Different team members will be leaders during different situations (Figure 3b, s1, s2, s3).



3a. Shared leadership



(s1) **(s2)** **(s3)**

3b. Distributed leadership

Figure 3. Structural dimension of social capital and leadership in collective teams (Adapted: DeRue (2011)); A-to-D indicates team members, and arrows indicate relationships and cooperation between team members.

In terms of cognitive and relational dimensions this study approves an underlying shared goal and understanding in each *collective* team. These concepts usually are injected to the team by the PO or the LM. The importance of the team task was explicitly mentioned to, and clarified for, the team. There is a high sense of trust and team spirit

and engagement in *collective* agile ISD teams and team members enjoy working together. *"Everybody here wants to do his best and add value. If we have something that makes sense, even if it takes a lot of work, we will understand this is important and we will commit to it." (A4/Dev(QE))*

Creating collective meaning is one of the most imperatives for creating *collective* agile ISD teams. The findings show that collective meaning contributes to both distributed and shared leadership in studied teams. This is in line with Day's (2000) discussion on leadership development and value creation for organizations. Collective meaning in *collective* agile ISD teams mainly comes from feedback; feedback from customers and feedback from the company. First, feedback from customers affects the perceived meaningfulness of the team's task. The influence of customer feedback on perceived meaningfulness has a dominant trace in interviews:

"*Every team member should have the chance to exchange with the customers and hear their feedback: 'Yeah! What you did is really right, it's cool, it's nice, it works, it's fantastic.' Then it really makes the feeling that what we do is in use. So this makes us happy at the end. […] So we see acceptance from the market. But there are tasks that we should do, but we really don't get feedback. […] So potentially there is a percentage of [our task] which isn't really meaningful. We don't see the market acceptance, unless we really see the feedback from customers." (C2/PO(LM))*

Second, collective meaning for teams also depends on company feedback. Findings show that since GlobDiv is just one of many divisions in the multinational software company, team members usually need the acknowledgement of the company that the team is important for the company. *"[What we do] is really big; it is so to say a 'cash-cow' for the company. It really matters to the company and that´s why we are really feeling this." (B3/Dev(QE))*

The notions of feedback from customers and feedback from company are consistent with the notions of meaningfulness and impact which Kirkman, Rosen, Tesluk, & Gibson (2004) have developed as two of the four facets of team psychological empowerment. The other two facets of psychological empowerment are potency (competency and expertise to do the job), and autonomy (freedom to do the job) (Kirkman et al.,

2004). Additionally, considering discussions on self-organization and expertise, it can be concluded that collective agile ISD teams benefit from a high sense of team psychological empowerment. Empowered teams set their own shared goals, self-organize themselves, and participate actively in decision making (Kirkman & Rosen, 1999). In sum, evenly distributed expertise, good connectivity, shared or evenly distributed leadership, team spirit, inner-team transparency, collective meaning, shared goals, language and identity are enablers of adaptive outcomes in *collective* agile ISD teams.

However, in the collective form of social capital in agile ISD teams, adaptive outcomes can be inhibited. First, the smooth teamwork, low and moderate task complexity and the collective leadership structure in collective agile ISD teams may put team members into a comfort zone. For instance, the PO of team A2, as a collective team, explained:

"We need to hear different opinions to find optimized solutions but at the beginning it was so difficult. […] In my team, people were not so comfortable to speak up and in this sense it is sometimes difficult to have different opinions. I knew it [was] not good because sometimes you can have different opinions or different ideas that can be very good for the team. […] At the beginning it was the matter of removing them from their comfort zone […], so we made use of retrospectives." (A2/PO)

Second, the findings show that low to moderate complexity of tasks may put members' motivation at risk. In ISD, maintenance tasks which involve a lower level of challenge and learning often demotivate members of ISD teams (Beecham et al., 2007). This will not be the case if the maintenance tasks are regarded as enhancements, which require a higher level of creative problem solving (Glass, 2002).

Third, the sense of shared goals and shared identity within the team may cause team members not to act in a way that threatens the team spirit. In the findings, I observe the phenomenon of "groupthink" within *collective* agile ISD teams. Groupthink is a psychological drive to minimize conflict and reach a consensus at any cost within a group of people (McAvoy & Butler, 2009; Ottaviani & Sørensen, 2001). The desire for uniformity and conformity causes team members to actively suppress disagreements and appraisal of alternatives (Janis, 1972; Ottaviani & Sørensen, 2001), which leads to dysfunctional decision making (Manz & Neck, 1997). Janis (1972) suggests high team co-

hesiveness and homogeneity of team members as two important antecedences of groupthink. Consequently, to avoid groupthink, and to reduce the risk of a comfort zone, the collective agile ISD teams in this study provide solutions to trigger critical decision making and enable adaptive outcomes.

To avoid the risk of groupthink in agile ISD teams McAvoy & Butler (2009) propose the role of devil's advocate in decision making, and call for the empirical evidence in agile ISD teams. The goal of the devil's advocate in teams is to examine and challenge any assumptions in decision making (Schwenk, 1988). Moreover, Uhl-Bien et al. (2007) argue that to foster adaptive outcomes within a system of people, "adaptive tension" should be injected to the system. In software development, adaptive tension results from "conflicts among the needs of stakeholders whose views shift and evolve as the development process progresses" (Mohan, Ramesh, & Sugumaran, 2010, p. 49). Relational assessment of the findings shows that to facilitate adaptive outcomes, collective agile ISD teams set rules or define appropriate roles. Also, key roles provide solutions for injecting adaptive tensions. The findings also show that some teams defined related backlog items to encourage creative problem solving, or to make sure solutions make their way to implementation. To be faithful to scrum principles, creative tasks are agreed upon during retrospectives, and to make sure the tasks are done and implemented, *collective* teams specify resources to the backlog during planning meetings.

5.2 Island

Island configuration indicates heterogeneous team members and high task complexity. As explained in detail in the findings section, the complexity level of each task is such that only very experienced and expert members can perform it. Usually *island* teams are formally or informally divided into sub-teams. The findings show that in some teams it is officially announced that the team is divided by sub-teams and each sub-team performs a set of very specific tasks. Team members in sub-teams are aware of the tasks in other sub-teams, but not in great detail. Each sub-team has a sub-team leader who is officially assigned to the sub-team. The sub-team leader is the most experienced person in the sub-team.

On the other hand, the findings indicate that in island teams, in which there is a high level of task complexity, tasks should be as granular as possible. Task granularity will help team members understand the task and perform it more efficiently. When island teams are not officially divided into sub-teams, each team member will be attracted to an island or sub-team. Similarly, each unofficial island or sub-team has a leader who is the most expert member in a specific topic. The findings are in line with Conger & Pearce (2003), who suggest if team members become experts in their tasks, one would expect more involvement in leadership functions. On the contrary, wide differences in expertise among team members would be an impediment to develop shared leadership (Conger & Pearce, 2003), since team members may not be inclined to follow someone who does not have high expertise in relevant fields (Conger & Pearce, 2003). Thus, heterogeneous teams are less likely than homogeneous teams to be able to develop shared leadership (Meindl, Mayo, & Pastor, 2003).

Figure 4 illustrates the structural dimension of *island* agile ISD teams. Experts in each island are the most dominant and powerful members. There is a low level of interconnection and interaction between islands within a team. The main interconnections with an *island* team mainly exist between the expert leader of the sub-team and the PO, the LM or customers. The PO has lower expertise and experience in comparison with expert leaders of each island, and the role of the SM as a facilitator is trivial.

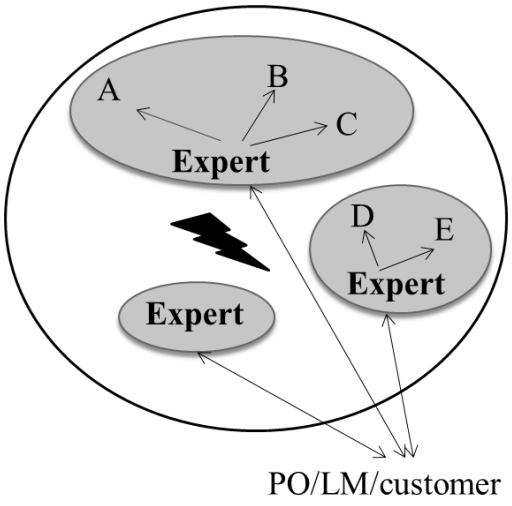


Figure 4. Structural dimension of social capital and leadership in island teams

Relational and cognitive assessment of data indicates that there are two main reasons for followers to be in a specific island: the perceived power of the expert leader and the follower's related skill. Findings show that *island* teams suffer from some types of team conflict. Team conflict is related to task conflict (e.g., conflicts about the distribution of resources, procedures and policies, and judgments and interpretation of facts), and inner-team relationship conflict (e.g., conflicts about personal taste, political preferences, values, and interpersonal style) (De Dreu & Weingart, 2003). Team conflict has a strong and negative relationship with team member satisfaction (De Dreu & Weingart, 2003). Different tastes, attitudes and styles among expert leaders of each island/sub-team increase the risk of low team member satisfaction and inter-team competition between islands/sub-teams. The findings also reveal that scrum principles are partially ignored in *island* teams, and team members experience differences of opinions over the implementation of scrum principles. Table 4 illustrates a wholistic view of social capital charactristics of agile ISD teams, and enablers and inhibitors of adaptive outcomes in each type.

On the other hand, adaptive outcomes emerge from authority and knowledge asymmetry interactions in a team (Uhl-Bien et al., 2007). There is a positive relationship between a team's functional heterogeneity and team creativity (Somech & Drach-Zahavy, 2013). The findings show that authority and knowledge asymmetries in island teams make them environments with high potential to produce adaptive outcomes such as creative problem solving and innovative ideas. Furthermore, expert leaders act as a devil's advocate and embrace uncertain situations to exhibit their level of expertise, and to experience new challenges.

For solutions to reduce *island* teams' risks, having a strong role of the SM as a facilitator and communication catalyzer is highly recommended by interviewees and informants. The SM will act as enabler between expert leaders and formal roles, facilitate inside-team interactions and protect the team against expert leaders' competition. This is the act of enabling and community building leadership which Uhl-Bien et al. (2007) and Hazy & Uhl-Bien (2013) argue will lead to adaptive outcomes. Table 5 summarizes solutions to overcome inhibitors of adaptive outcomes.

Table 4. Social capital charactristics of agile ISD teams, and enablers and inhibitors of adaptive outcomes in each type

	Characteristics	Enablers of adaptive outcomes	Inhibitors of adaptive outcomes
Collective teams	• Members equal expertise • High level tasks (low backlog granularity, low/moderate complexity) • Highly connected tasks • Committed to scrum principles (e.g., an expert PO and a facilitating SM) • Able to locate expertise outside team borders	• Evenly distributed expertise • Shared or evenly distributed leadership • Good connectivity • Team spirit and coherence • High transparency • Collective meaning • Shared goal, language and identity	• Risk of the comfort zone • Risk of low motivation • Risk of groupthink
Island teams	• Highly expert members vs. other members • Complex tasks, granular backlogs • Missing team facilitator • Inside team experts highly committed to doing the tasks	• Create solutions to perform complex and novel tasks • Benefit from high expertise that can react efficiently to uncertainty	• Risk of lack of team spirit and coherence • Risk of inner-team competition • Risk of low member satisfaction • Risk of conflicting individual, sub-team and team goals

Table 5. Solutions to overcome inhibitors of adaptive outcomes in agile ISD teams

Solutions to overcome inhibitors	Selected quote
Inject adaptive tensions: Devil's advocacy: (e.g., critical thinkers, drivers)	*We came to the idea of "drivers" in a retrospective meeting. Because sometimes [people] don't feel so responsible. They say, "this is not working, [so] I am waiting." Now the drivers should more push the guys [and ask] "did you solve it?" […]* *We don't always have enough experience; we are always getting new topics, really new topics, and the drivers should more or less ask the people [to find solutions] and ask, "is your task solved now?" (B4/PO)*

Intentional discussions and challenges	*Some conflicts are good because through the conflict you can have a better solution. One colleague in the team is my counterpart. We usually start creating good conflicts; we start having discussions to encourage colleagues to share different opinions. […] For example, I proposed a way to calculate taxes. But there are other possible ways to do this, or other possible outputs. [However], since I am the most experienced colleague the group decided that [my opinion on tax calculation] is the expected [solution] and leads to expected results. But we started to create discussions on that. We found different ideas that were better than the previous initial ideas… (A2/PO)*
Define specific backlog items	*If somebody has new idea he [she] brings it in a retrospective. Then if the team agrees that it is a good idea we will formulate it in a backlog item. Then the person who proposed this idea will be the owner of the backlog and anybody interested will help [implementing the idea]. (B3/APO(LM))*
Balance:	
Team and product goals	*Sometimes you need to evaluate the priorities between team and product. Sometimes just thinking about the product may lead to decisions that the team may not like so much. So it´s better to be responsible for both things and balance [both]. (B2/Dev(QE))*
Development and maintenance tasks	*Scrum is doing quite well except for customer messages. You are not really able to plan it, because the customer decides on his own, he is creating the customer message without knowing our point of view… It is taking a lot of capacity out of the things we are developing. Although we are a scrum team and having our own sprints, someone else is putting something into our sprint, which is five weeks long in our case, and saying, "this thing needs to be done in two weeks". We have already started the sprint and it is the middle of the sprint and we cannot do this anymore. So customer messages and development should be planned in a proper portion. (B3/Dev(QE))*
Power and expertise	*We had a very good Scrum Master; she is now on maternity leave. When she was here, she was very active, trying to talk to colleagues and encourage them to communicate and make a unique goal. Now I should do all the stuff and sometimes it is too much. (C4/PO)*
Create collective meaning, trust and team spirit	

6 Conclusion and Contributions

In this study I have interpreted my field research associated with agile ISD teams in a division of a global software company, identifying the dimensions of social capital and leadership development in agile ISD teams, and how adaptive outcomes are generated within those teams. This study contributes to research on agile ISD teams in three ways: first, by drawing on a theoretical framework that is grounded in social capital dimensions; secondly, by demonstrating that the social nature of agile ISD teams goes beyond the literature found in the agile field; and thirdly, by pointing to new and promising directions for future research. This study has taken a more careful look into social intrapersonal and interpersonal interactions in a highly knowledge-based and knowledge-dependent context of agile ISD teams by focusing on team adaptability during uncertain situations. The social capital assessment of agile ISD teams unfolded two different team configurations in terms of structural, cognitive and relational dimensions: *collective* and *island*. There are two basic underlying differences between these two team configurations: task complexity and connectivity, and team homogeneity.

On one hand, structurally collective agile ISD teams are those teams with homogenous team member expertise and experience, and low to moderate task complexity. In collective agile ISD teams, shared or distributed leadership develops during the decision making process or in uncertain situations. Relationally, collective teams experience a high level of psychological empowerment, and cognitively share the same team goal and vision. On the other hand, structurally island-configured agile ISD teams are those teams with heterogeneous member expertise and experience and a high level of task complexity. Normally, in island teams, formal or informal sub-teams are configured. Each sub-team is led by a highly expert member. Island teams are highly efficient and professional, enabling them to respond effectively to uncertain situations and produce adaptive outcomes.

This study is an initial effort to understand the creation of adaptive outcomes in the socially intensive network of agile ISD teams, which are designed not so much for innovation, but for rapid improvisation and quick response to customer requirements. This study finds that in collective agile ISD teams there are risks of comfort zone, low employee motivation and groupthink. These risks are considered to be the inhibitors of

adaptive outcomes. Also, the risk of insufficient team spirit and coherence, inside team competition, low member satisfaction, and conflicting individual and sub-team and team goals may inhibit adaptive outcomes in island teams. Furthermore, this study proposes solutions to overcome inhibitors of adaptive outcomes in both types of agile ISD teams. Solutions include: injecting adaptive tensions, defining specific backlog items for creative and adaptive ideas, balancing team and product goals, development and maintenance tasks as well as power and expertise, and, overall, creating psychological empowerment within teams by making goals transparent and meaningful to team members. Although some previous research advocates certain findings in learning and innovation literature, this study gives a holistic view on inhibitors and facilitators of adaptive outcomes in agile ISD.

Furthermore, this study pushes the boundaries of shared and distributed leadership development by responding to the call for rigorous research on the topic of leadership and social capital development (Day et al., 2014). By adopting the social capital perspective, this study goes beyond the human capital perspective and uncovers the development of leadership in the highly knowledge-intensive context of agile ISD. Pearce and Barkus (2004) have suggested that the likelihood of one individual being able to accomplish the task components on his/her own is lower in terms of the highly complex task environment. Moreover, Cox, Pearce, & Perry (2003) suggest that greater task complexity facilitates shared leadership. However, the findings show that highly complex tasks in agile ISD teams will turn teams into islands that are led by dominant experts in the specific expert area. In island teams shared or even distributed leadership is less likely to develop.

This study also has valuable implications for practitioners and agile mentors. As Lin et al. (2001, p. 6) discuss, “the premise behind the notion of social capital is rather simple and straightforward: investment in social relations with expected return”. Understanding the structural configuration of agile ISD teams and the relational and cognitive resources embedded in each configuration enables managers to configure teams in such a way that they can reach expected outcomes. Investment in different social relations and configurations will lead to either higher adaptability or efficiency. This study provides valuable solutions with which to overcome inhibitors of adaptive outcomes in agile ISD

teams, based on the successful experience of the studied agile ISD teams and previous rigorous research.

I also suggest that the following limitations need to be taken into account: first, I collected data from a single large multi-national software company to control for organizational culture and structures. However, further studies are needed to conduct similar studies in small and medium size enterprises (SMEs) or in start-up companies to see whether different organizational culture and structures influence complexity leadership. Second, I only interviewed a few key roles per team. Covering all team members for interview might have enabled me to discover more leadership practices and might have opened up new perspectives of team adaptability. Third, I interviewed team members in three different countries and in my findings did not control for cultural differences. Further consideration of cultural differences is believed to be useful.

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Chapter 5

CONCLUSION

This chapter includes the summary of research findings and theoretical and practical implications of Paper 1, Paper 2, and Paper 3 at a glance:

1 Summary of the Research Findings

Paper 1. Based on the categorization scheme of Edmondson et al. (2007), we examine three perspectives on team learning applied to the field of ISD and highlight their distinct characteristics, assumptions, and limitations: (1) the team learning curve, (2) shared knowledge and group memory, and (3) team learning behavior. In addition to these streams, we identify an innovative approach to research team learning in ISD which takes a structural and relational perspective. We present several aspects which these streams of research can cross-fertilize. We emphasize team leader behavior, learning goals and task characteristics as concepts which ISD team learning research has widely neglected by contrasting team learning in ISD to related disciplines. We also highlight several implications for ISD methodology and management, especially in globally distributed settings and agile development practices.

Paper 2. Based on Complexity Leadership Theory (Uhl-Bien et al., 2007), the case study of twelve agile ISD teams revealed that agile ISD teams face three main tensions that bring the team into disequilibrium. To reduce or balance disequilibrium, agile ISD teams self-organize themselves through two sequential mechanisms: *information/knowledge diffusion* and *osmosis*. During these two mechanisms, emergent leaders are highly expert and experienced members or groups of members. This means that during self-organization, leadership responsibilities will be shifted to a group of individuals whose expertise is most relevant to the given problem (Friedrich, Vessey, Schuelke, Ruark, & Mumford, 2009). However, the findings revealed that during diffusion and osmosis the "emergent leadership" is *not* an adaptive leadership in the sense that adaptive leadership is a facilitator or producer of adaptive outcomes. In Scrum, the outcomes are pre-defined backlog items including tasks or customer requirements. Subsequently, the observations show that the outcomes of emergent leadership are usually technical solutions for the requirement or task. Information/knowledge diffusion and osmosis are patterns through which an agile ISD team leverages to adapt itself to the tension. Therefore, these mechanisms are inherent in team adaptability and not adaptive

outcomes. This study also suggests several practices of administrative and enabling leadership during times of tension.

Paper 3. Based of social capital theory, this study has taken a more careful look into social intrapersonal and interpersonal interactions in a highly knowledge-based and knowledge-dependent context of agile ISD teams by focusing on team adaptability during uncertain situations. The social capital assessment of agile ISD teams unfolded two different team configurations in terms of structural, cognitive and relational dimensions: *collective* and *island*. There are two basic underlying differences between these two team configurations: task complexity and connectivity, and team homogeneity.

On one hand, structurally collective agile ISD teams are those teams with homogenous team member expertise and experience, and low to moderate task complexity. In collective agile ISD teams, shared or distributed leadership develops during the decision making process or in uncertain situations. Relationally, collective teams experience a high level of psychological empowerment, and cognitively share the same team goal and vision. On the other hand, structurally island-configured agile ISD teams are those teams with heterogeneous member expertise and experience and a high level of task complexity. Normally, in island teams, formal or informal sub-teams are configured. Each sub-team is led by a highly expert member. Island teams are highly efficient and professional, enabling them to respond effectively to uncertain situations and produce adaptive outcomes.

Furthermore, this study proposes enablers and inhibitors of adaptive outcomes in both teams and suggests solutions to overcome inhibitors of adaptive outcomes in both types of agile ISD teams. Solutions include: injecting adaptive tensions, defining specific backlog items for creative and adaptive ideas, balancing team and product goals, development and maintenance tasks as well as power and expertise, and, overall, creating psychological empowerment within teams by making goals transparent and meaningful to team members.

2 Theoretical Implications

Paper 1. With regard to ISD methodology, team learning research makes several contributions and depicts potential areas for future investigations. First, the findings on

team autonomy, which is a central aspect in agile development methods such as extreme programming, are not consistent (Janz and Prasarnphanich 2009; Vidgen and Wang 2009; Nemanich et al. 2010). They indicate that different types of team autonomy can stimulate different team behaviors, but not all of them improve performance. Research might address the question of what kind of autonomy should be given to ISD teams in different contexts in order to simultaneously stimulate learning and increase performance. Next, increased development of multiple skills by team members and reduced specialization, which are found in lean software development approaches (see Dybå and Dingsøyr 2008; Poppendieck and Poppendieck 2003), influence team learning behavior by reducing the need for awareness of expertise location (Vidgen and Wang 2009; Maruping et al. 2009). However, this does not necessarily lead to higher team creativity or performance as developing similar skills reduces the heterogeneity of expertise and potentially fruitful task conflicts (Tiwana and Mclean 2005; Liang et al. 2010). Under certain conditions, hierarchical team structures with specialist roles can actually foster team learning (Bunderson and Boumgarden 2010). Future research should, therefore, investigate in which cases in ISD an agile team of generalists can perform better and in which cases a hierarchical team structure with several specialists might be superior. Finally, at least some development practices manipulate the relative influence of team learning on software quality in ISD (Maruping et al. 2009). However, which specific developer behaviors are triggered by such practices remains obscure so far. Revealing these behaviors and their underlying mechanisms would constitute a significant step in understanding the relationship between development methodology, team learning, and team performance (Maruping et al. 2009).

Paper 2. I believe that considering an agile ISD team as a unit of analysis for CLT, through an embedded case study design, opens up new horizons for within-case and cross-case analysis of CAS contexts. Therefore, this study provides a fertile opportunity for the empirical study of CAS. This study contributes to research on CLT and consequently on complexity leadership in two ways: first, my findings highlight that in a highly knowledge-based and knowledge-dependent context, leadership is extensively influenced by sources of information or knowledge. As scholars have discussed, the richest or the most knowledgeable sources within a system will turn to emergent leaders (Friedrich et al., 2009; Majchrzak, Jarvenpaa, & Hollingshead, 2007). These emergent

leaders will help the team to return to equilibrium. During the processes of coming back to equilibrium, many enabling and administrative leadership practices might occur. However, findings challenge the occurrence of the adaptive leadership element of CLT during tension, despite highly active enabling leadership. Second, the findings highlight that agile ISD teams such as CAS are self-organizing and are able to respond to the tension; yet the outcomes for such teams are pre-defined and tasks are highly granular. In such circumstances the response to uncertainty and tension will only be limited to problem solving and optimization of the processes to lower the pressure and to free resources such as time and expertise. Further research could draw on the nature of the tasks each agile team should perform, in order to trace adaptive outcomes through self-organization during tension.

Findings also contribute to ISD research. First, the findings highlight different practices on administrative and enabling leadership during tension. This enables the ISD research to not only focus on the adaptive nature of leadership in agile ISD teams, but also to shed light on administrative leadership, apart from the administrative roles and settings of agile ISD approaches. Second, the findings inform ISD leadership research to go beyond the individual roles of leaders in ISD and to focus on mechanisms that lead the team during different conditions. Overall, my findings contribute to the question of *whether CAS as self-organizing systems are adaptive*; and *whether this adaptability only involves the system adaptability to respond to the change, or it involves to adaptive outcomes*. This research suggests that to study the outcomes of complexity leadership the constraints of the context should be taken into account (e.g., Scrum).

Paper 3. This study contributes to research on agile ISD teams in three ways: first, by drawing on a theoretical framework that is grounded in social capital dimensions; secondly, by demonstrating that the social nature of agile ISD teams goes beyond the literature found in the agile field; and thirdly, by pointing to new and promising directions for future research.

This study is an initial effort to understand the creation of adaptive outcomes in the socially intensive network of agile ISD teams, which are designed not so much for innovation, but for rapid improvisation and quick response to customer requirements. This study finds that in collective agile ISD teams there are risks of comfort zone, low em-

ployee motivation and groupthink. These risks are considered to be the inhibitors of adaptive outcomes. Also, the risk of insufficient team spirit and coherence, inside team competition, low member satisfaction, and conflicting individual and sub-team and team goals may inhibit adaptive outcomes in island teams. Although some previous research advocates certain findings in learning and innovation literature, this study gives a holistic view on inhibitors and facilitators of adaptive outcomes in agile ISD.

Moreover, this study pushes the boundaries of shared and distributed leadership development by responding to the call for rigorous research on the topic of leadership and social capital development (Day et al., 2014). By adopting the social capital perspective, this study goes beyond the human capital perspective and uncovers the development of leadership in the highly knowledge-intensive context of agile ISD. Pearce and Barkus (2004) have suggested that the likelihood of one individual being able to accomplish the task components on his/her own is lower in terms of the highly complex task environment. Moreover, Cox, Pearce, & Perry (2003) suggest that greater task complexity facilitates shared leadership. However, the findings show that highly complex tasks in agile ISD teams will turn teams into islands that are led by dominant experts in the specific expert area. In island teams shared or even distributed leadership is less likely to develop.

3 Practical Implications

Paper 1. One of the most prominent fields of research in ISD management is concerned with globally distributed software development projects. An enormous challenge in such a setting is the management of culturally diverse ISD team members. Research is continuously trying to discover and explain effective management practices to address it (Levina and Vaast 2008; Gregory 2010). Team learning scholars have contributed to this endeavor by finding mechanisms which stimulate the creation of a common group memory (Kotlarsky and Oshri 2005; Kanawattanachai and Yoo 2007, Oshri et al. 2008). They have also highlighted the existence of different situational prerequisites to and inhibitors of learning activities across the global team, such as trust, psychological safety, and aspects of collocation (Staples and Webster 2008; Van der Vegt et al. 2010; Choo 2011). Notably, team learning scholars have recently argued that globally distributed team members might actually never be able to develop a real shared mental model

because of their different backgrounds. Instead, creating cross-understanding is proposed as a better solution (Huber and Lewis 2010). The implication for global ISD management is that team members should be brought into a position to understand each others' various values and manner of thinking rather than striving to create one single "negotiated culture" (Gregory 2010, p.6). Future research should investigate which underlying team processes can be stimulated in order to create such cross-understanding.

Team learning research also provides an explanation why personnel turnover is an important cost driver in offshore ISD (Dibbern et al. 2008). When single members leave the team, the existing group memory is negatively impacted, causing a decrease in team performance on occasions when such loss is not successfully accounted for by management (Lewis et al. 2007). Since not all individuals are equally central to team learning activities and knowledge flows (Skerlavaj et al. 2010; Sarker et al. 2011), the loss of a single developer can potentially corrupt the entire memory system within an ISD team. As such, future research should investigate how actors who are pivotal to the team's learning activities can be identified so that timely precautions are taken to address their central role within the team with special care.

Paper 2. Findings in this study have several implications for practitioners: first, a detailed list of leadership practices is offered to help an agile ISD recover its equilibrium and overcome typical ISD tensions. Second, the patterns of self-organization bring awareness to managers to better understand and compose their teams in a way that their agile teams react more efficiently to a tension. Third, the findings highlight that in order for adaptive outcomes to happen, enabling leadership is involved by inserting adaptive tension; administrative leadership is involved by loosening Scrum structures through defining adaptive backlogs. This awareness has made agile ISD advocates re-think Scrum structures and consider the role of enabling leadership for adaptive outcomes.

Paper 3. This study has valuable implications for practitioners and agile mentors. As Lin et al. (2001, p. 6) discuss, "the premise behind the notion of social capital is rather simple and straightforward: investment in social relations with expected return". Understanding the structural configuration of agile ISD teams and the relational and cognitive resources embedded in each configuration enables managers to configure teams in such a way that they can reach expected outcomes. Investment in different social relations

and configurations will lead to either higher adaptability or efficiency. This study provides valuable solutions with which to overcome inhibitors of adaptive outcomes in agile ISD teams, based on the successful experience of the studied agile ISD teams and previous rigorous research.

4 Limitations and Future Research

Paper 2 and 3. I also suggest that the following limitations need to be taken into account: first, I collected data from a single large multi-national software company to control for organizational culture and structures. However, further studies are needed to conduct similar studies in small and medium size enterprises (SMEs) or start-up companies to see whether different organizational culture and structures influence complexity leadership. Second, I only interviewed a few key roles per team. Covering all team members for interview might have enabled me to discover more leadership practices and might have opened up new perspectives of team adaptability. Third, I interviewed team members in three different countries and in the findings did not control for cultural differences. Further consideration of cultural differences is believed to be useful.

5 Concluding Remarks

Studying leadership as a process is a fruitful field for IS researchers. IT leadership research is still in its infancy, and I believe we need to begin exploring these complex and social issues of ISD teams in earnest. As Hunt & Dodge (2000) declared such research is not suitable to the "quick and easy" questionnaire approach to which we have become accustomed. This does not mean, however, that it cannot be tested; only that it may be more difficult (Uhl-Bien et. al 2009). This difficulty, however, "does not justify quick, one-shot studies (Hunt & Dodge, 2000, p. 454). Instead, it requires methodologies that "allow us to gather rich, dynamic, contextual and longitudinal data that focus on processes (mechanisms) rather than static, decontextualized variables" (Uhl-Bien & Marion, 2009, p. 647).

I believe this study is a step forward to bring new insights into ISD research. From the initiation to the completion of this dissertation, partial findings were presented several times to ISD managers and agile mentors and advocates. I had the privilege to benefit

from high expertise and support from practitioners. However, I should add that the concept of leadership, as a collective process, is not a concept that some managers want to hear about both in terms of the concept itself, and in terms of the non-“quick and easy questionnaire” approach of research methodology. Nonetheless, I am honored to unravel barriers of studying “leadership” for this dissertation.

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APPENDIX A: SEMI-STUCTURED INTERVIEW PROTOCOL[1]

Thank you for participating in this research.

Please introduce your ROLE and your TASK

1. **Decision Making**

- How are decisions made in your team?
- How differences of opinion are handled within your team?
- Are there any influential team members, who have influence over decisions made in the team?
- Are there people outside the team, who have influence over important operational decisions?

2. **Experimentation and Testing of Assumptions**

- When an idea or suggestion that seems impractical or likely to meet with a lot of opposition is brought to your team, either by a member or an outsider, how does your team deal with it?
- Can you tell me about a time when someone on the team tried her/his new idea? Does this happen often?

3. **Seeking Information and Feedback**

- How does your team get the information it needs to do its job?
- Can you tell me about a time when the team went out to get additional information that you needed?

4. **Team Reflection (e.g., Performance, Review meetings, Retrospectives)**

- Can you tell me how usually the performance of your team is being assessed?

[1] I thank Professor Amy Edmondson from Harvard Business School for sharing with me her interview protocol database on learning.

- How improvements or changes are made to the way your team operates?

5. Uncertainties or Urgencies

- Can you describe a time when this team really worked together as a team -- a major problem you handled successfully, some event, and some success in the team's history? *(Key factors, Influential roles and relations)*
- Can you recall a time when you felt the team really couldn't operate well as a team? A failure, early days, major changes, and a problem you couldn't handle? *(To get improved factors, roles and relations)*
- Do you see any continuing difficulties that this team has in working together? *(To get improved factors, roles and relations)*

- **Roots of uncertainty/urgency:**

a) *Requirements:*

Lack in details of functionality and business context, Ambiguous information, Requirement changes

b) *Human Resources:*

Absence, New team member, Unclear role and responsibility (Coordination)

c) *Task Environment:*

Unexpected dependencies between tasks, unclear task sequences and processes

d) *Situational Urgency:*

Unrelated/Related interruptions, Underestimated work effort

6. **Give me a number between 1 (completely disagree/dissatisfied) to 7 (completely agree/satisfied). If necessary, tell me why you chose this number[2].**

- My team has confidence in itself, (potency)
- My team can get a lot done when it works hard, (potency)
- My team believes that it can be very productive, (potency)
- My team believes that its projects are significant, (meaningfulness)
- My team feels that its tasks are worthwhile, (meaningfulness)
- My team feels that its work is meaningful, (meaningfulness)
- My team can select different ways to do the team's work, (autonomy)
- My team determines as a team how things are done in the team, (autonomy)
- My team makes its own choices without being told by management, (autonomy)
- My team has a positive impact on this company's customers, (impact)
- My team performs tasks that matter to this company, (impact)
- My team makes a difference in this organization, (impact)

Do you have any further points of improvement for your team and comments for this research?

[2] This section is adapted from the questionnaire proposed by Kirkman et al., (2004) on psychological empowerment.

APPENDIX B: PUBLICATIONS

Publications Related to This Dissertation

Gholami, B., & Kapdan E. (2014). Shared Leadership in Agile Information Systems Development Teams: Unraveling Uncertainties. Working Paper

Gholami, B. (2013). Agile Information Systems Development Teams: Is Empowerment Taken for Granted? In *International Research Workshop on IT Project Management 2013*.

Gholami, B., & Heinzl, A. (2013). Leading Agile Self-Organizing Teams: A Collective Learning Perspective (p. Paper 183). In *International Conference on Organizational Learning, Knowledge and Capabilities (OLKC2013), Washington DC. USA.*

Further Publications

Gholami, B., & Murugesan, S. (2013). Global IT Project Management Using Web 2.0. In J. Wang (Ed.), *Perspectives and Techniques for Improving Information Technology Project Management*. IGI Global.

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APPENDIX C: SUPERVISIONS

Master Theses

- Towards Understanding Shared Leadership in Agile Software Development Teams: A Contingency Approach, Emre Kapdan, 2014
- Leadership Styles in Agile Software Development Teams, Latha Selvanadurajan, 2013
- Team Composition and Its Impact on Team Leaning in Agile Software Development, Oana Tudorascu, 2012

Seminar Papers

- Leadership in Information Systems Development Teams, Master Seminar, Franziska Knoblauch, 2013
- Social and Adaptive Interactions in Agile Software Development Teams, Master Seminar, Ruixing Yang, 2013
- Implicit Team Learning in Information Systems Development: A Literature Review, Master Seminar, Natalie Klimakin, 2012
- Learning in Crowdsourcing Environments, Bachelor Seminar, Steve Schmidt, 2012
- The Concept of Learning in Information Systems Research, Bachelor Seminar, Hakan Peker, 2011

RÉSUMÉ

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