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Putting the "Socio" into the Development of Socio-Technical Systems – The Case for Psychological Safety in Agile Information Systems Development

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Investigating the "Socio" in Socio-Technical Development: The Case for Psychological Safety in Agile Information Systems Development

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ABSTRACT

Information system development is largely dependent on social interaction and team work. Team processes and behavior among, as well as agile practices used by, team members play an important part for the success of information system development projects. To reap benefits from the highly interactive and social practices of agile information systems development, team members need to feel save to interact and speak freely with one another. In this paper, we propose a model that conceptualizes the effects of psychological safety and agile practices on performance in agile information systems development. The proposed model combines recent research in the field of organizational psychology with agile information system research to provide a better understanding of the team-level effects at play in agile information systems development and is preliminary supported by case studies conducted in two large insurance companies and a small-to-medium sized software development company.

Keywords

Agile Software Development, Psychological Safety, Performance, Information Systems Development, Project Management, Team Climate

INTRODUCTION

Agile information system development (AISD) methods are increasingly popular in industry (Conboy 2009; Dybå and Dingsøyr 2008; Fitzgerald et al. 2006; Lee and Xia 2010; Williams 2012). With an increasing need for AISD team management, it has become important to understand the mechanisms of action in AISD teams (Lee and Xia 2010; Persson et al. 2012; Sarker et al. 2009).

Team-level research in AISD, however, is scarce (Lee and Xia 2010), although AISD is mostly conducted in teams and is quintessentially a team effort (Siau et al. 2010). Moreover, not only do practitioners call for more research on social aspects of AISD teams (Freudenberg and Sharp 2010) – scant research on social aspects of the development of socio-technical systems, that information systems are, exist (e.g., Long and Siau 2007; Sawyer et al. 2010; van Kelle et al. 2015). However, due to the increased importance of social interactions in AISD compared to traditional approaches (Hummel et al. 2015), team-level effects in AISD likely differ and social aspects may vary. Importantly, our knowledge of the AISD process itself is often characterized as a "black box" (Siau et al. 2010, p. 92); only little AISD research goes beyond AISD methods, and there is a need for theory and studies about social behavior and processes of communication, negotiation, and learning (Kautz et al. 2007, p. 235).

Information systems researchers therefore call for more conceptual and empirical research on team-level effects in AISD (Conboy 2009; Mangalaraj et al. 2009; McAvoy and Butler 2009; McAvoy et al. 2013). While different concepts could be investigated as important team-level effects, *psychological safety (PS)*, which originates from concepts such as leadership style or cohesiveness, is seen by research in organizational behavior as one of the most important ones. Research found PS to affect and moderate a latitude of team-level effects (Martins et al. 2013; Roberge and van Dick 2010), among them learning, innovativeness, self-reflection, and overall performance. Due to the importance of social interactions in AISD and its reliance on self-organization and self-reflection, PS may play an important role in moderating the effects of AISD practices as well.

To open the black box of the AISD process and conceptualize this for the domain of AISD, we include and adapt findings of team and organizational behavior research. Promising recent (e.g., Bunderson and Boumgarden 2010; Carmeli and Gittell 2009; Schulte et al. 2012) and well-established research (e.g., Edmondson 1999) on PS and its influence on performance has not yet been integrated. We therefore propose a model to investigate the effects of PS on the success of agile practices. Specifically, we suggest that *social agile practices* (SAPs; Hummel et al. 2015) are likely to affect and to be affected by PS and therefore have an indirect effect on performance.

To provide a first evaluation of this model, we conducted a multiple case study in two major insurance companies and a software development company. Based upon these interviews, we performed a two-step coding process, starting with pattern coding with codes derived from literature, followed by hypothesis coding. This coding process led us to confirm our hypotheses and derive implications for research and practice regarding the importance of PS for successful AISD teams. Providing deeper insights into benefits and presuppositions of AISD practices aids research and practice. These insights could help to reduce the number of failed projects and increase job satisfaction—therefore leading to a decrease in costs.

Following, we give an overview about related work, derive the proposed model and corresponding propositions, and describe the cases and coding process. Finally, we discuss our results and implications.

RELATED WORK

Information Systems Development and Agile Approaches

IS are often developed in the form of projects (Hirschheim et al. 1995, p. 33), with many involved stakeholders and project team members (Chae and Poole 2005). The nature of AISD is in many aspects intangible (Cule et al. 2000), and the major problems of AISD projects are not so much technological as sociological in nature (DeMarco and Lister 1987, p. 4). Coordination and communication are necessary for successful implementation (Gallivan and Keil 2003; Ko et al. 2005), and creating a shared understanding is deemed to be a major driver for AISD success (Corvera Charaf et al. 2013; Gallivan and Keil 2003; Rosenkranz et al. 2013; Tan 1994).

In practice, approaches for developing IS range from sequential (Royce 1970) to more cyclic, iterative approaches (Boehm 1988). AISD methodologies (Cao et al. 2009; Vidgen and Wang 2009) trade strict control for more flexibility and autonomy within the team, the overall development process is not planned and scheduled upfront, and progress is made in small iterative phases, while encouraging change and constant feedback (Cockburn and Highsmith 2001; Highsmith and Cockburn 2001). Planning becomes a permanent task, and team leadership is established via collaboration and is separated from project lead (Dybå and Dingsøyr 2008; Dybå and Dingsøyr 2009).

While the team is thus highlighted as the crucial aspect of AISD in practice, extant research in the field of AISD methods has investigated mainly specific and individual or organizational phenomena, such as the use and effects of specific agile practices (e.g., Balijepally et al. 2009; Holmqvist and Pessi 2006; Maruping et al. 2009b), or effects regarding whole projects or organizations, such as the introduction of AISD methods to teams (e.g., Cao et al. 2009; Heeager 2012; Hong et al. 2011; Kotlarsky 2007; Mangalaraj et al. 2009).

As research thus covers the individual and organization-wide level of effects on AISD, team-level effects are covered less so, and existing results are contradictory. Team research has included technology as an influencing factor of team work (e.g., Kozlowski and Ilgen 2006), but specific features of AISD have not been observed. Research found that cohesive teams are the optimal base for applying agile practices (Cao et al. 2009; Fruhling and de Vreede 2006), while other studies suggest that diversity amplifies creativity and problem-solving ability (Bear and Woolley 2011; Lee and Xia 2010; Phillips et al. 2006) and therefore might provide benefits for AISD. These inconsistencies are especially important for AISD, as AISD teams rely heavily on efficiency (to respond quickly to changes; Conboy 2009) and problem-solving ability (to complete complex, non-routine tasks; Lee and Xia 2010).

Team Resilience

One concept closely linked to efficiency and problem-solving ability (i.e., team effects), is team resilience (Meneghel et al. 2016). AISD explicitly acknowledges the importance of being able to respond to requirement changes and even embrace change and an ever-changing environment (Beck et al. 2001). As changes impose difficulties for the team,

AISD teams have to have the capacity to recover quickly from changes and difficulties, which is the textbook definition of resilience (Oxford English Dictionary).

Resilience in general has been used in biology to describe the ability of a dynamic multispecies ecological system to persist with the same basic structure when subjected to stress (Holling 1973). Derived from this, researchers have used team resilience to describe a team's ability to "withstand disruptive factors, synonymous with both buffering against disruptive factors and correcting for disruptive factors without significant strategic changes" (Chakravarty et al. 2013, p. 983). Recent research found a direct influence of team resilience on performance (Meneghel et al. 2016).

As AISD explicitly stresses the importance of being able to respond to requirement changes (Beck et al. 2001), resilience is an important team-trait for successfully AISD, as changes in requirements is one of the main reasons AISD projects fail (Maruping et al. 2009a).

Psychological Safety

To develop resilience, a team has to be able to critically review itself and its success. Team members therefore have to feel that they can voice concerns and critique and feel safe to take interpersonal risks by doing so. PS, "a shared belief held by members of a team that the team is safe for interpersonal risk taking" (Edmondson 1999, p. 354), has been used by researchers to explain organizational learning (Nembhard and Edmondson 2006), information sharing, and how team members are motivated to speak up for improvements (Detert and Burris 2007; Liang et al. 2012) or to take initiatives to innovate (Baer and Frese 2003). Structure has been found to foster PS, especially in self-managed teams, and to improve team learning (Bunderson and Boumgarden 2010). Other research found an influence of PS on the ability to learn from failures (Carmeli and Gittell 2009; Jehn et al. 2014).

Furthermore, PS has been found to moderate (i.e., mitigate) the negative effect of diversity on performance (Roberge and van Dick 2010). Other research found a direct effect on performance (Schaubroeck et al. 2011). Others find that PS is an important predictor for performance, especially in diverse teams (Singh et al. 2013).

In sum, extant research has applied theories of organizational psychology while being focused on IT use than on AISD (e.g., Gorecki et al. 2008; Nan 2011; Wang and Hahn 2015). While research on teams thus is not completely new to AISD research, PS has not been investigated by AISD research.

THEORY DEVELOPMENT

Considering that research yet has to identify the preconditions for successful implementation of AISD, we propose to contribute to closing this research gap with this model. Specifically, we argue that SAPs in and of themselves do not necessarily provide any benefit to performance. Instead we propose that this benefit can only be realized if team members feel that they can speak freely and voice concerns or give alternative, possibly controversial, solutions. Therefore, PS might moderate the effect of SAPs. If the team is not feeling save (i.e., low PS), the AISD practices only provide marginal benefits or even reduce performance. If, however, the team does feel save (i.e., high PS), SAPs unfold their full potential and performance benefits from the implementation of SAPs. We further argue that SAPs lay the groundwork for PS in AISD teams by providing safe environments (e.g., via daily standup meetings) and fostering mutual support and responsibility (e.g., via collective code ownership).

While these phenomena have been investigated on their own and mainly in the context of general or occasional teams, AISD research has not put these theories together and evaluated these effects in the specific context of AISD teams, although AISD methods rely heavily on team work, team composition, communication, and interpersonal relationships (Beck et al. 2001; Lee and Xia 2010; Maruping et al. 2009a; Rosenkranz et al. 2013; Sawyer et al. 2010). If our assumptions hold true, the proposed model helps in explaining team-level effects in AISD and in turn gives guidance to improve team resilience and performance. Figure 1 displays our proposed model and Table 1 summarizes the constructs.

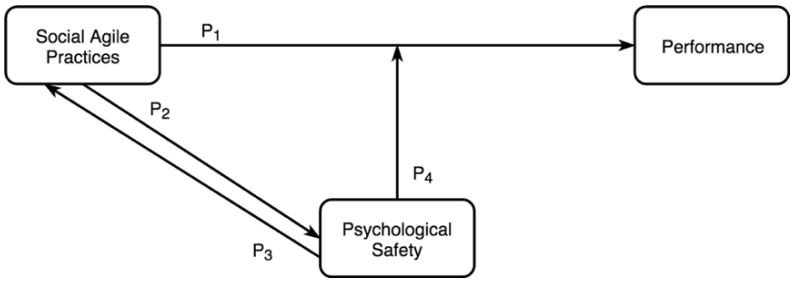

Figure 1. Proposed Research Model

Name	Definition	References
Social Agile Practices (SAPs)	Agile practices entailing communication practices or practices aiming at exchanging knowledge and facilitating interpersonal interaction (e.g., daily scrums, retrospectives, or pair programming).	Hummel et al. (2015)
Psychological Safety (PS)	Psychological safety is defined as "a shared belief held by members of a team that the team is safe for interpersonal risk taking" (Edmondson 1999, p. 354), meaning that team members are more likely to engage in behaviors such as seeking feedback, asking for help, speaking up about concerns or mistakes, or coming up with innovative ideas when psychological safety is high.	Edmondson (1999)
Performance	Composed of on-time completion, on-budget completion, software functionality, and resilience. Resilience describes how quickly a team is likely to recover or bounce back from failure once failure has occurred. Also defined as "being able to withstand disruptive factors, synonymous with both buffering against disruptive factors and correcting for disruptive factors without significant strategic changes" (Chakravarty et al. 2013, p. 983).	Lee and Xia (2010) Alliger et al. (2015) Hashimoto et al. (1982) Chakravarty et al. (2013)

Table 1. Construct Summaries

Extant research found that structure helps self-managed teams to improve their learning from failures (Bunderson and Boumgarden 2010). As SAPs provide this structure (both in the form of daily routines, e.g. daily stand up meetings, and in the form of mentoring and help-providing structures, e.g. through pair programming or collective code ownership), we argue that the usage of SAPs positively influences performance and we propose P_1:

P_1: *Usage of Social Agile Practices positively affects Performance.*

Linking PS with AISD, we argue that SAPs foster PS by providing a safe environment for speaking up (e.g., during daily stand up meetings or sprint reviews) and by creating a perception of shared responsibility and mutual support (e.g., via shared code ownership or pair programming), because structure (e.g., provided by daily stand up meetings or mentoring during pair programming) has been found to be beneficial to PS (Bunderson and Boumgarden 2010). This results in proposition P_4:

P_2: *Usage of Social Agile Practices positively affects Psychological Safety.*

PS plays an important role regarding social interaction in teams (Baer and Frese 2003; Detert and Burris 2007; Liang et al. 2012; Nembhard and Edmondson 2006). Especially in regard to the emphasis, SAPs place on social interaction, PS acts as an enabler for SAPs, by empowering team members to speak freely with one another, cooperate, and resolve conflicts (Roberge and van Dick 2010). Therefore, we postulate proposition P_3:

P_3: *Psychological Safety enforces SAPs.*

Building upon this argument for P_3, PS not only enforces SAPs, it is a prerequisite for SAPs to unfold their positive effects. Without feeling safe to voice concerns (e.g., during reviews or pair programming), SAPs are destined to be less successful than when team members feel safe to engage in SAPs. P_4 resembles this proposition:

P_4: *Psychological Safety enables and enforces the positive effect of SAPs on Performance.*

RESEARCH DESIGN

Case Overviews and Data Collection

To evaluate our propositions and our proposed model, we conducted an embedded, confirmatory multiple case study (Yin 2003, p. 49) with in three different case organizations (see Table 2). The cases were sampled following a convenience sampling strategy and all surveyed organizational units are based in Germany. Two of these cases are set in large insurance companies (Insure1 and Insure2), one of which is active internationally and one nationally. The third case (Develop1), as a contrast, is set in a small-to-medium sized software development company, focusing on Business-to-Business (B2B) services. Develop1 incorporated agile practices eight years ago, Insure1 and Insure2 both are in the process of agile transformation, which started in both cases a little over a year ago.

We collected data from various data sources and with different data collection methods. Semi-structured interviews and project documentation were used to generate data. We interviewed both project managers and project workers. Administrative documents, work descriptions, interview transcripts, and field notes were collected in a case study database. We collected data from July 2018 to August 2018 while conducting 13 face-to-face interviews at the organizations' site (see Table 3). The guideline was not shared with the interviewees and we only used it as a checklist and outline. The aim was to encourage the interviewees to provide a narrative of their experiences as freely as possible. All participants of Insure1 and Insure2 were part of an agile transformation team, enabling us to gain an overview over all agile teams and, more importantly, were able to tell us about any "Lessons Learned". All participants from Develop1 were part of the development team.

Name	Industry	Size	State of Agile Adoption
Insure1	Insurance	Large, international company	Agile transformation in progress
Insure2	Insurance	Large, national company	Agile transformation in progress
Develop1	B2B Software Development	Small to medium size	Adopted since founding in 2010

Table 2. Case Overview

Name	Case	Role / Assignment
Tom	Insure1	Specialist for IT portfolio management in the agile transformation team
Josephine	Insure1	Specialist charged with initial set-up of soon-to-be agile teams
Lily	Insure1	Specialist for change management in the agile transformation team
June	Insure1	Specialist charged with creating a team vision in the agile transformation team
Tyler	Insure2	Team leader of the agile transformation team
Mike	Insure2	Product architect and scrum master
Juliet	Insure2	Specialist for quality assurance
Eugene	Insure2	Program Manager for Insure2
George	Insure2	Specialist for strategy and enterprise architecture in the agile transformation team
Cedric	Develop1	Scrum master
Nicholas	Develop1	Specialist for software and application architecture
Mary	Develop1	Developer and tester
Joshua	Develop1	Developer

Table 3. Participant Overview

While loosely following the guideline, space for probing and open questions was available. During these interviews, the participants were asked about the implemented agile practices and about team work in general. Further, we asked participants about their perceptions of the applicability and success of agile practices as well as team climate and interactions between team members. Our guidelines were derived from extant literature. The interviews lasted about 60 minutes and were recorded and transcribed. This resulted in about 169 recorded transcript pages. Follow-up e-mails were sent to request clarifications and to offer informants the possibility to provide feedback and comments.

The interview protocol and guideline were checked against Bouchard (1976) and Mishler (1986). The guideline was especially checked regarding the sequence of questions; however, since the interviews were basically open, as few direct questions as possible were asked and leading questions were avoided (Loftus 1975).

Data Analysis

Coding techniques and checklists (Miles and Huberman 1994b, pp. 170-244; Yin 2003, pp. 109-138) were afterwards used to connect data with constructs from our model and the propositions. The data analysis process is outlined in Figure 2. Following Saldaña (2016), we applied different coding strategies. At the core is the task of conceptualization, that is, "the process of grouping similar items according to some defined properties and giving the items a name that stands for that common link" (Strauss and Corbin 1998, p. 121). As coding can be seen as "cyclical act" (Saldaña 2016), our coding process therefore can be distinguished between a first and second step.

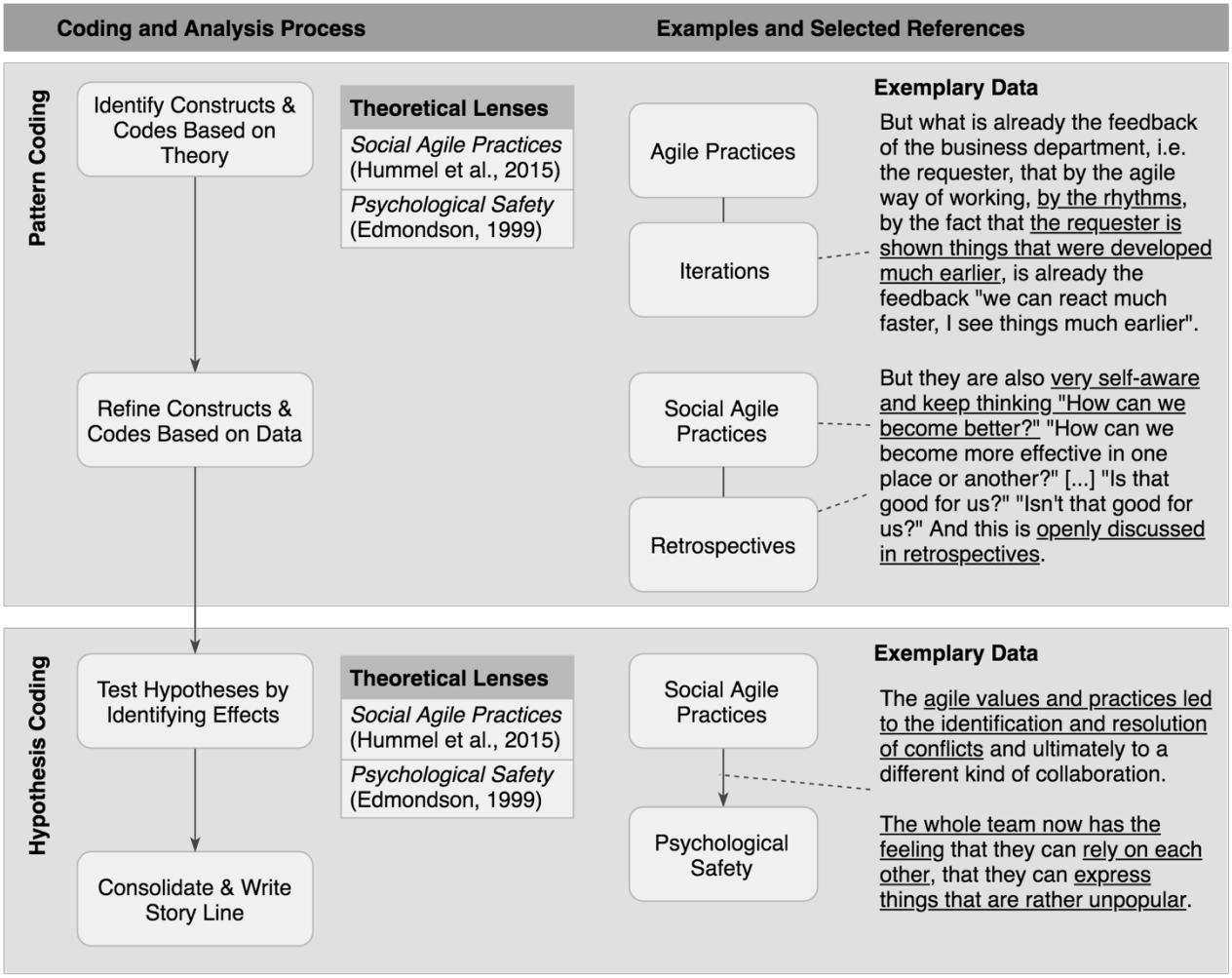

Figure 2. Coding Process with Illustrations

First, we derived the codes from extant literature and our proposed model (displayed in Table 4). Extant literature predetermines our codes as, for instance, the sets of available SAPs are already identified by Hummel et al. (2015) and Tripp et al. (2016). Based on these predetermined codes, we set out to identify and refine our proposed constructs by means of *pattern coding* as described by Miles and Huberman (1994a) and Saldaña (2016). Pattern coding is appropriate for the development of major themes from data (Miles and Huberman 1994a; Saldaña 2016). These codes are capable to "identify an emergent theme" and therefore are helpful for "grouping those summaries into a smaller number of sets, themes, or constructs" (Miles and Huberman 1994a, p. 69). The theoretical lenses of SAPs (Hummel et al. 2015) and PS (Edmondson 1999) served as guidelines.

The second coding step in our coding process follows *hypothesis coding* as described by Weber (1990), Russell Bernard (2002), and Saldaña (2016). In this step, we aimed at identifying statements in the conducted interviews to support or reject our propositions. Once again, the theoretical lenses of SAPs (Hummel et al. 2015) and PS (Edmondson 1999) served as guidelines for coding the interviews.

We followed three tactics to increase construct validity (Lee 1989b; Yin 2003, pp. 40-44). We used multiple sources of evidence (multiple key informants) and established a chain of evidence (project diary) during data collection. Furthermore, all key informants reviewed draft reports of the case study. In the data analysis of this case study, we addressed internal validity by pattern matching (linking the propositions and constructs to data from the case study diary) and explicit explanation-building. Since this case study was explicitly designed to test the propositions of our model, we used replication logic in the setup of multiple case studies for ensuring external validity. The multiple case study design was explicitly chosen to ensure analytical generalization. For addressing reliability, for each case in this study, we collected transcripts and protocols from the interviews. Following Dibbern et al. (2008) and based on Dubé and Paré (2003), **Fehler! Verweisquelle konnte nicht gefunden werden.** gives a detailed overview about the attributes used to assess the case study's rigor.

RESULTS

The resulting coding matrix is displayed in Table 4. As can be seen, all three cases implement a similar, yet different set of agile practices. Also, the levels of PS are slightly different between the cases. However, all three cases aim for a high level of PS:

> *"It is very important to Insure1 that employees can always give their honest opinion." (Tom, Q1)*

> *"The wonderful thing is that you don't have to be afraid that some statement will be used against you, because you might be evaluated thereafter." (Josephine, Q2)*

> *"It is very important to me [...] that they know that I am a totally open guy [...] and that they can and should say everything they care about." (Tyler, Q3)*

> *"Yes, it's very friendly here, very humane." (Cedric, Q4)*

Code Group	Code	Insure1	Insure2	Develop1
Social Agile Practices	Daily Stand Ups	X	X	X
	Reviews & Retrospectives	X	X	X
	Pair Programming	(X)	X	(X)
	Sprint Planning & Prioritization	X	X	X
	Collective Code Ownership			X
	Cross-Functional Teams	X	X	X
	... affect Psychological Safety	X	X	
	... affect Performance	X	X	X
Psychological Safety	High	X	X	X
	Medium	(X)		X
	Low	(X)	(X)	
	... affects SAPs	X	X	X
	... moderates SAPs → Performance	X	X	X
Performance	... increased with SAPs	X	X	X
	... decreases with SAPs	(X)	(X)	

Table 4. Identified Codes and Codings.
X marks a clearly identified code, while (X) marks a peripheral phenomenon or less clearly identified code.

The few instances, in which a less safe environment was mentioned were either in relation to situations before the agile-transformation:

> *"[if someone made a mistake, ...] there was often the escalation towards project management before." (George, Q5)*

or in relation to (emotional or task) conflicts, which arose at the very beginning of the agile transformation process due to the increased transparency and interdependency of work but always were resolved later on:

> *"Partly where it was simply a matter of not including some people who felt that they were being overlooked, and that actually led to conflicts. [...] These were both, personal conflicts as well as professional ones. [...] However, the team often found this resolution-process very fruitful. One has developed a joint solution and thus there is a better feeling later. Everyone has contributed and is involved. Everyone has a bringing-us-together function, so the team is more connected." (June, Q6)*

Two of three cases showed a partial negative effect of SAPs on performance:

> *"There were also team members who said, 'this is all bullshit and does us no good.'" (Tom, Q7)*

However, these team members changed their attitude later on or their attitude was based on fear for increased transparency on their work:

> *"That is a safeguard, some do not want to make their work transparent, because then one would see what someone is doing and what not." (June, Q8)*

> *"[there are some who] were very hostile and played with prejudices who now [...] if something goes well, say 'sure, we did that the agile way.'" (June, Q9)*

In regard to our propositions and as displayed in Table 4, we found support for all four propositions as displayed in Figure 1 and outlined in the section "Theory Development". Support for proposition P_1 can be found in all three cases:

> *"In my opinion, Scrum helps to really deliver quality." (Mike, Q10)*

> *"I know they [the team] perform and that we're in roll-out now. And obviously—it worked." (George, Q11)*

> *"And towards the end we had actual change requests. [...] There you can see the complete harmony between what I expected and what I got." (George, Q12)*

Similarly, proposition P_2 is supported by two of three cases. One aspect, as identified by Lily, is that by "forcing" people together, by promoting social interactions, people are more likely to develop a common understanding:

> *"You can't avoid each other. [...] You're already working things out together. You must at least create a basic understanding together and through this you must speak a common language. So, we have invested a lot of time in a common understanding [...]. However, I believe that this is very valuable in the long term." (Lily, Q13)*

George made a very similar argument. He thinks that an iterative approach, combined with learning and a common vision helps in establishing trust:

> *"All this didn't work overnight. It has gone through a process and trust has been built up among each other. And you can actually say that people have grown more attached to each other and what you produce here as a product [...] that can be sold on the market, that's their baby. They developed a deep identification with their work." (George, Q14)*

Support for proposition P_3 can be found in all three cases, but participants of Insure1 were especially outspoken about the effects of a safe environment on the agile practices:

> *"Colleagues should simply be open - to new topics and simply have fun trying things out." (Josephine, Q15)*

> *"I think to be able to work really well together, it is important to be part of the team." (Lily, Q16)*

The cyclical relationship between PS and SAPs, which results from P_2 and P_3, has been raised by participants as well:

> *"Many have not yet understood this concept of a learning organization either. 'Why do you do this different now again?' 'We've only just gotten used to the old way. Why does it have to be any different now?' And these constant changes over and over again, that is just really difficult for some people." (Josephine, Q18)*

However, this resistance can be tackled by employing change management tactics. The same applies for the partially negative effects of SAPs mentioned beforehand. For instance:

> *"Just look at the team a bit, have a little more sense for the needs. And you have to sell why you want to do it this way." (Lily, Q19)*

Insure2 reiterates that PS influences their way of work and the selection of SAPs:

> *"In the end, we simply encourage the team members to get involved and perhaps make suggestions on how to improve processes." (Eugene, Q20)*

> *"This is the agreement: You do your thing. I trust you, and I got your backs – and this deal unfolds creativity and motivation. It's not easy to copy because it's based on rather soft factors." (George, Q21)*

Finally, we see support for proposition P_4 in all three cases as well. Some statements were less clear:

> *"I think that this works very well, as long as you have a scrum team, which works well as a team." (Mike, Q22)*

which hint at a trusting and friendly (i.e., psychologically safe) team as a prerequisite for success of AISD practices. Other statements were clearer but discussing the effects of low PS:

> *"Sure, it becomes very transparent how I do something, how I work. [...] you also have to share a lot. And that's just difficult for many people at first." (Josephine, Q23)*

> *"Sometimes there was pure rejection and statements like "we have tried agile before and it didn't work". If you look more closely and ask what went wrong - this had nothing to do with Scrum or the methodology, but rather with conflicts in the team that had not been resolved." (June, Q24)*

On the other hand, we found similarly clear statements discussing the effects of high PS in Develop1. Asked about the most important success factors for the success of their agile implementation, Cedric said:

> *"Communication, honesty, and candor." (Cedric, Q25)*

These three factors are all linked to PS, as PS is based around honesty and candor and improves communication.

Combining all statements, we find support for all our propositions, which leads to implications for both research and practice and opens new avenues for future research.

DISCUSSION AND IMPLICATIONS

As AISD methods rely heavily on team work, communication, interpersonal relationships, and social interaction in general (Beck et al. 2001; Lee and Xia 2010; Maruping et al. 2009a; Rosenkranz et al. 2013; Sawyer et al. 2010), a supportive, friendly, and open environment is clearly a hotbed for successful AISD implementation. Further, we found evidence for the influence of SAPs on performance in general (e.g., Q10) and resilience in particular (e.g., Q12). We outlined in the previous section and displayed in Table 4 the support for all our propositions, especially for the importance of PS – leading to a supportive, friendly, and open environment. We therefore believe that PS plays an important role for the success of SAPs. The collected data suggests, that PS plays two significant, cyclical roles in AISD.

First, PS determines if team members accept SAPs (e.g., Q18). If PS is low team members are less likely to partake in planning meetings and retrospectives. If, in contrast, PS is high, team members are more likely to accept SAPs and give them a try.

Second, PS determines how team members participate in SAPs (e.g., Q22). If PS is low and they do participate in SAPs, they are less likely to speak their minds, are less likely to give valuable input to achieve a successful outcomes, and are less likely to offer ideas for continuous improvement. In contrast, a higher PS leads to more engagement, more helping behavior, and an increased willingness to offer new ideas and give valuable input which ultimately leads to improved outcomes and a learning organization.

However, if PS is low, it can be improved and strengthened by implementing SAPs carefully (e.g., Q13). As we have seen in the previous section, it is important to apply change management tactics and listen to the needs and concerns of team members.

Taken together, these two roles stress that while SAPs rely on and are influenced by PS, PS is enforced by SAPs, indicating that SAPs are not static, but to some degree dynamic (e.g., Q14) in their implementations.

This study therefore opens up new avenues for future research. Having support for the influence of PS means that research now should investigate in more detail, which boundary conditions are in effect for PS to influence SAPs. Further, a quantitative evaluation of this model could yield additional insights. Due to the qualitative nature of this study, we have no indication for the strength and significance of the identified effects. A quantitative follow-up study would also increase the confidence in our results.

For practitioners, these results have important implications as well. First and foremost a psychological safe environment appears extremely important to successful implementation of AISD methods. This means that before and during an agile transformation an open and honest environment without fear for retribution or penalties has to be created and reinforced. Second, practitioners should be aware of the cyclic relationship between SAPs and PS. While PS is a precondition for successful AISD implementation, SAPs enforce PS and PS influences the engagement of team members in SAPs and their selection of preferred SAPs. This concept of a learning organization is seen as a threat by some team members, but with appropriate change management, this constant process refinement can be beneficial to both team members and the organization as a whole.

However, this study is not without limitations. First, this study considers only three different cases, two of which are similar in industry, size, and state of agile adoption. The third, as the sole contrasting case, has only limited explanatory power. By increasing the number of cases, our findings could be refined and gain in validity if confirmed. Second, all three companies are based in Germany, with only one company being part of an international organization. Future research could conduct similar studies in other countries and cultural regions to evaluate the influence of cultural aspects on the importance of PS. Third, we did not conduct interviews with every team member. It is likely that the perceptions of the specific team's level of PS and its influence on the success of SAPs varies. We believe this difference to be of only peripheral nature and to not have a significant effect on our conclusions due to the very homogeneous nature of the statements in all interviews. The fourth limitation is the influence of social desirability bias (SDB), as it is generally more socially desirable to report success rather than failure. Nederhof (1985) suggests postulating questions that are neutral. We tried to minimize the SDB emerging from our questions. However, due to the clear preferability of success over failure, SDB was still likely to emerge from questions during our interviews.

CONCLUSION

In this paper, we argued for a novel model, explaining the interplay between PS and AISD practices. We gave an overview over the findings of recent decade's research on team-level effects in AISD and deduced the model from extant research. Further, we evaluated said model and discussed implications for both theory and practice. Limitations were discussed as well as avenues for future research on team-level effects in AISD to further improve AISD as well as help to reduce failed AISD projects.

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REFERENCES

Alliger, G. M., Cerasoli, C. P., Tannenbaum, S. I., and Vessey, W. B. 2015. "Team Resilience," *Organizational Dynamics* (44), pp. 176-184.

Baer, M., and Frese, M. 2003. "Innovation Is Not Enough: Climates for Initiative and Psychological Safety, Process Innovations, and Firm Performance," *Journal of organizational behavior* (24:1), pp. 45-68.

Balijepally, V., Mahapatra, R., Nerur, S., and Price, K. H. 2009. "Are Two Heads Better Than One for Software Development? The Productivity Paradox of Pair Programming," *MIS Quarterly* (33:1), pp. 91-119.

Bear, J. B., and Woolley, A. W. 2011. "The Role of Gender in Team Collaboration and Performance," *Interdisciplinary Science Reviews* (36:2), pp. 146-153.

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., and Thomas, D. 2001. "Manifesto for Agile Software Development." *Manifesto for Agile Software Development* Retrieved February 24, 2016, from http://www.agilemanifesto.org/

Boehm, B. W. 1988. "A Spiral Model of Software Development and Enhancement," *IEEE Computer* (21:4), pp. 61-72.

Bouchard, T. J. 1976. "Field Research Methods: Interviewing, Questionnaires, Participant Observation, Systematic Observation, Unobtrusive Measures," in *Handbook of Lndustrial and Organizational Psychology,* M.D. Dunnette (ed.). Chicago, IL, USA: Rand McNally.

Bunderson, J. S., and Boumgarden, P. 2010. "Structure and Learning in Self-Managed Teams: Why "Bureaucratic" Teams Can Be Better Learners," *Organization Science* (21:3), pp. 609-624.

Cao, L., Mohan, K., Xu, P., and Ramesh, B. 2009. "A Framework for Adapting Agile Development Methodologies," *European Journal of Information Systems* (18:4), pp. 332-343.

Carmeli, A., and Gittell, J. H. 2009. "High-Quality Relationships, Psychological Safety, and Learning from Failures in Work Organizations," *Journal of Organizational Behavior* (30:6), pp. 709-729.

Chae, B., and Poole, M. S. 2005. "The Surface of Emergence in Systems Development: Agency, Institutions, and Large-Scale Information Systems," *European Journal of Information Systems* (14:1), pp. 19-36.

Chakravarty, A., Grewal, R., and Sambamurthy, V. 2013. "Information Technology Competencies, Organizational Agility, and Firm Performance: Enabling and Facilitating Roles," *Information Systems Research* (24:4), pp. 976-998.

Cockburn, A., and Highsmith, J. 2001. "Agile Software Development: The People Factor," *IEEE Computer* (34:11), pp. 131-133.

Conboy, K. 2009. "Agility from First Principles: Reconstructing the Concept of Agility in Information Systems Development," *Information Systems Research* (20:3), pp. 329-355.

Corvera Charaf, M., Rosenkranz, C., and Holten, R. 2013. "The Emergence of Shared Understanding: Applying Functional Pragmatics to Study the Requirements Development Process," *Information Systems Journal* (23:2), pp. 115-135.

Cule, P., Schmidt, R., Lyytinen, K., and Keil, M. 2000. "Strategies for Heading Off Is Project Failure," *Information Systems Management* (17:2), pp. 65-73.

DeMarco, T., and Lister, T. 1987. *Peopleware: Productive Projects and Teams*. Dorset House Publishing Co., Inc. New York, NY, USA.

Detert, J. R., and Burris, E. R. 2007. "Leadership Behavior and Employee Voice: Is the Door Really Open?," *Academy of Management Journal* (50:4), pp. 869-884.

Dibbern, J., Winkler, J., and Heinzl, A. 2008. "Explaining Variations in Client Extra Costs between Software Projects Offshored to India," *MIS Quarterly* (32:2), pp. 333-366.

Dubé, L., and Paré, G. 2003. "Rigor in Information Systems Positivist Case Research: Current Practices, Trends, and Recommendations," *MIS Quarterly* (27:4), pp. 597-635.

Dybå, T., and Dingsøyr, T. 2008. "Empirical Studies of Agile Software Development: A Systematic Review," *Information and software technology* (50:9), pp. 833-859.

Dybå, T., and Dingsøyr, T. 2009. "What Do We Know About Agile Software Development?," *IEEE Software* (26:5), pp. 6-9.

Edmondson, A. 1999. "Psychological Safety and Learning Behavior in Work Teams," *Administrative science quarterly* (44:2), pp. 350-383.

Fitzgerald, B., Hartnett, G., and Conboy, K. 2006. "Customising Agile Methods to Software Practices at Intel Shannon," *European Journal of Information Systems* (15:2).

Freudenberg, S., and Sharp, H. 2010. "The Top 10 Burning Research Questions from Practitioners," *Ieee Software* (27:5), pp. 8-9.

Fruhling, A., and de Vreede, G.-J. 2006. "Field Experiences with Extreme Programming: Developing an Emergency Response System," *Journal of Management Information Systems* (22:4), pp. 39-69.

Gallivan, M. J., and Keil, M. 2003. "The User-Developer Communication Process: A Critical Case Study," *Information Systems Journal* (13:1), pp. 37-68.

Gorecki, J., Berthon, P., DesAutels, P., Donnellan, B., and Teigland, R. 2008. "The Multinational's Nemesis: The Rise of Ict-Enabled Distributed Collective Intelligence?," in: *ICIS 2008 Proceedings*. pp. 1-6.

Hashimoto, T., Loucks, D. P., and Stedinger, J. R. 1982. "Reliability, Resiliency, Robustness, and Vulnerability Criteria for Water Resource Systems," *Water Resources Research* (18:1).

Heeager, L. T. 2012. "Introducing Agile Practices in a Documentation-Driven Software Development Practice: A Case Study," *Journal of Information Technology Case and Application Research* (14:1), pp. 3-24.

Highsmith, J., and Cockburn, A. 2001. "Agile Software Development: The Business of Innovation," *IEEE Computer* (34:9), pp. 120-122.

Hirschheim, R., Klein, H., and Lyytinen, K. 1995. *Information Systems Development and Data Modeling. Conceptual and Philosophical Foundations*. Cambridge, England: Cambridge University Press.

Holling, C. S. 1973. "Resilience and Stability of Ecological Systems," *Annual review of ecology and systematics* (4:1), pp. 1-23.

Holmqvist, M., and Pessi, K. 2006. "Agility through Scenario Development and Continuous Implementation: A Global Aftermarket Logistics Case," *European Journal of Information Systems* (15:2).

Hong, W., Thong, J. Y. L., Chasalow, L. C., and Dhillon, G. 2011. "User Acceptance of Agile Information Systems: A Model and Empirical Test," *Journal of Management Information Systems* (28:1), pp. 235-273.

Hummel, M., Rosenkranz, C., and Holten, R. 2015. "The Role of Social Agile Practices for Direct and Indirect Communication in Information Systems Development Teams," *Communications of the Association for Information Systems* (36), pp. 273-300.

Jehn, K. A., Jonsen, K., and Rispens, S. 2014. "Relationships at Work: Intragroup Confligc and the Continuation of Task and Social Relationships in Workgroups," *Current Topics in Management* (17).

Kautz, K., Madsen, S., and Nørbjerg, J. 2007. "Persistent Problems and Practices in Information Systems Development," *Information Systems Journal* (17), pp. 217–239.

Ko, D.-G., Kirsch, L. J., and King, W. R. 2005. "Antecedents of Knowledge Transfer from Consultants to Clients in Enterprise System Implementations," *MIS Quarterly* (29:1), pp. 59-85.

Kotlarsky, J. 2007. "Re-Engineering at Lecroy Corporation: The Move to Component-Based Systems," *Journal of Information Technology* (22:4), pp. 465-478.

Kozlowski, S. W., and Ilgen, D. R. 2006. "Enhancing the Effectiveness of Work Groups and Teams," *Psychological Ccience in the Public Interest* (7:3), pp. 77-124.

Lee, A. S. 1989a. "Case Studies as Natural Experiments," *Human Relations* (42:2), pp. 117-137.

Lee, A. S. 1989b. "A Scientific Methodology for Mis Case Studies," *MIS Quarterly* (13:1), pp. 32-50.

Lee, A. S. 1991. "Integrating Positivist and Interpretive Approaches to Organizational Research," *Organization Science* (2:4), pp. 342-365.

Lee, G., and Xia, W. 2010. "Toward Agile: An Integrated Analysis of Quantitative and Qualitative Field Data on Software Development Agility," *MIS Quarterly* (34:1), pp. 87-115.

Liang, J., Farh, C. I., and Farh, J.-L. 2012. "Psychological Antecedents of Promotive and Prohibitive Voice: A Two-Wave Examination," *Academy of Management Journal* (55:1), pp. 71-92.

Loftus, E. 1975. "Leading Questions and the Eye Witness Report," *Cognitive Psychology* (7:4), pp. 560-572.

Long, Y., and Siau, K. 2007. "Social Network Structures in Open Source Software Development Teams," *Journal of Database Management* (18:2), pp. 25-40.

Mangalaraj, G., Mahapatra, R., and Nerur, S. 2009. "Acceptance of Software Process Innovations - the Case of Extreme Programming," *European Journal of Information Systems* (18:4), pp. 344-354.

Martins, L. L., Schilpzand, M. C., Kirkman, B. L., Ivanaj, S., and Ivanaj, V. 2013. "A Contingency View of the Effects of Cognitive Diversity on Team Performance: The Moderating Roles of Team Psychological Safety and Relationship Conflict," *Small Group Research* (44:2), pp. 96-126.

Maruping, L. M., Venkatesh, V., and Agarwal, R. 2009a. "A Control Theory Perspective on Agile Methodology Use and Changing User Requirements," *Information Systems Research* (20:3), pp. 377-400.

Maruping, L. M., Zhang, X., and Venkatesh, V. 2009b. "Role of Collective Ownership and Coding Standards in Coordinating Expertise in Software Project Teams," *European Journal of Information Systems* (18:4), pp. 355-371.

McAvoy, J., and Butler, T. 2009. "A Failure to Learn by Software Developers: Inhibiting the Adoption of an Agile Software Development Methodology," *Journal of Information Technology Case and Application Research* (11:1), pp. 23-46.

McAvoy, J., Nagle, T., and Sammon, D. 2013. "Using Mindfulness to Examine Isd Agility," *Information Systems Journal* (23:2), pp. 155-173.

Meneghel, I., Salanova, M., and Martínez, I. M. 2016. "Feeling Good Makes Us Stronger: How Team Resilience Mediates the Effect of Positive Emotions on Team Performance," *Journal of Happiness Studies* (17:1), pp. 239-255.

Miles, M. B., and Huberman, A. M. 1994a. *Qualitative Data Analysis : An Expanded Sourcebook*. Thousand Oaks: Sage Publications.

Miles, M. B., and Huberman, A. M. 1994b. *Qualitative Data Analysis: A Sourcebook of New Methods*. Beverly Hills, CA, USA: Sage.

Mishler, E. G. 1986. *Research Interviewing: Context and Narrative*. Cambridge, MA, USA: Harvard University Press.

Nan, N. 2011. "Capturing Bottom-up Information Technology Use Processes: A Complext Adaptive Systems Model," *MIS Quarterly* (35:2), pp. 505-540.

Nederhof, A. J. 1985. "Methods of Coping with Social Desirability Bias: A Review," *European journal of social psychology* (15:3), pp. 263-280.

Nembhard, I. M., and Edmondson, A. C. 2006. "Making It Safe: The Effects of Leader Inclusiveness and Professional Status on Psychological Safety and Improvement Efforts in Health Care Teams," *Journal of Organizational Behavior* (27:7), pp. 941-966.

Oxford English Dictionary. *"Resilience"*. Oxford University Press.

Persson, J. S., Mathiassen, L., and Aaen, I. 2012. "Agile Distributed Software Development: Enacting Control through Media and Context," *Information Systems Journal* (22:6), pp. 411-434.

Phillips, K. W., Northcraft, G. B., and Neale, M. A. 2006. "Surface-Level Diversity and Decision-Making in Groups: When Does Deep-Level Similarity Help?," *Group processes & intergroup relations* (9:4), pp. 467-482.

Roberge, M.-E., and van Dick, R. 2010. "Recognizing the Benefits of Diversity: When and How Does Diversity Increase Group Performance?," *Human Resource Management Review* (20:4), pp. 295-308.

Rosenkranz, C., Corvera Charaf, M., and Holten, R. 2013. "Language Quality in Requirements Development: Tracing Communication in the Process of Information Systems Development," *Journal of Information Technology* (28:3), pp. 198-223.

Royce, W. W. 1970. "Managing the Development of Large Software Systems: Concepts and Techniques," *Proceedings of WesCon*.

Russell Bernard, H. 2002. "Research Methods in Anthropology-Qualitative and Quantitative Approaches,").

Saldaña, J. 2016. *The Coding Manual for Qualitative Researchers*. London: SAGE.

Sarker, S., Munson, C. L., Sarker, S., and Chakraborty, S. 2009. "Assessing the Relative Contribution of the Facets of Agility to Distributed Systems Development Success: An Analytic Hierarchy Process Approach," *European Journal of Information Systems* (18:4), pp. 285-299.

Sawyer, S., Guinan, P. J., and Cooprider, J. 2010. "Social Interactions of Information Systems Development Teams: A Performance Perspective," *Information Systems Journal* (20:1), pp. 81-107.

Schaubroeck, J., Lam, S. S., and Peng, A. C. 2011. "Cognition-Based and Affect-Based Trust as Mediators of Leader Behavior Influences on Team Performance," *Journal of Applied Psychology* (96:4), p. 863.

Schulte, M., Cohen, N. A., and Klein, K. J. 2012. "The Coevolution of Network Ties and Perceptions of Team Psychological Safety," *Organization Science* (23:2), pp. 564-581.

Siau, K., Long, Y., and Ling, M. 2010. "Toward a Unified Model of Information Systems Development Success," *Journal of Database Management* (21:1), pp. 80-101.

Singh, B., Winkel, D. E., and Selvarajan, T. 2013. "Managing Diversity at Work: Does Psychological Safety Hold the Key to Racial Differences in Employee Performance?," *Journal of Occupational and Organizational Psychology* (86:2), pp. 242-263.

Strauss, A., and Corbin, J. 1998. *Basics of Qualitative Research*. London: Sage.

Tan, M. 1994. "Establishing Mutual Understanding in Systems Design: An Empirical Study," *Journal of Management Information Systems* (10:4), pp. 159-182.

Tripp, J. F., Riemenschneider, C., and Thatcher, J. B. 2016. "Job Satisfaction in Agile Development Teams: Agile Development as Work Redesign," *Journal of the Association for Information Systems* (17:4), p. 267.

van Kelle, E., van der Wijst, P., Plaat, A., and Visser, J. 2015. "An Empirical Study into Social Success Factors for Agile Software Development," *Proceedings of the Eighth International Workshop on Cooperative and Human Aspects of Software Engineering*: IEEE Press, pp. 77-80.

Vidgen, R., and Wang, X. 2009. "Coevolving Systems and the Organization of Agile Software Development," *Information Systems Research* (20:3), pp. 355-376.

Wang, Z., and Hahn, J. 2015. "Crowd Experience and Performance: An Empirical Analysis of Crowdsourced New Product Development," in: *ICIS 2015 Proceedings*. pp. 1-20.

Weber, R. P. 1990. *Basic Content Analysis*. Sage.

Williams, L. 2012. "What Agile Teams Think of Agile Principles," *Communications of the ACM* (55:4), pp. 71-76.

Yin, R. K. 2003. *Case Study Research: Design and Methods*, (3 ed.). Thousand Oaks, CA, USA et al.: SAGE Publications.

APPENDIX A

Research Design	
Nature of study	Positivist, explanatory study recognizing subjective and interpretive elements in every research (cf. Lee 1989a; Lee 1989b; Lee 1991)
Clear research questions	Yes.
A priori specification of constructs	Yes (explanatory character).
Clean theoretical slate	No, propositions were formulated a priori (explanatory character).
Theory of interest	Psychological safety
Rival theory included	No, because it was the first test of the model.
Multiple case design	Yes, three organizations with multiple projects, with every project representing a case (with multiple projects embedded).
Replication logic	Both theoretical and literal replication logic.
Unit of analysis	Projects in three different companies; however, all case studies are embedded and involve more than one unit of analysis. This occurs when, within a single case, attention is also given to a subunit or subunits. Although the specific projects represent the main unit of analysis, the individual project team members represent a subunit. Any subunit is part of/or embedded in the larger system (i.e., project) and it is important to understand the subunits in the larger system.
Pilot case	Not conducted, since it is highly recommended for exploratory studies only.
Team-based research	Yes, three researchers.
Different roles of investigators	First author and another researcher undertook data collection. First author and another researcher coded and interpreted the data independently before discussing and resolving differences. Second author acted as discussant and challenger for the data.
Context Description	
Detailed site description	Yes.
Case period	The case material was collected during a period of 2 months with several onsite visits and phone calls.
Longitudinal design	No.
Time spent onsite by the researchers	Yes, for setting up the case study design, for conducting interviews.
Nature of data collection	Both retrospective and on-going.
Data Collection Process	
Multiple data collection methods	Yes; data was solicited from different stakeholders via interviews; administrative documents, work descriptions, print-outs of project reports, interview transcripts and field notes were collected and added to the analysis.
Qualitative and quantitative data	Mostly qualitative.
Data triangulation	Yes.
Case study protocol	Yes.
Case study database	Yes, using MaxQDA and Microsoft Excel.
Data Collection Methods	
Interviews	Yes.
Documentation	Yes (e.g., administrative documents for project and interviewee selection).
Observation	No.
Questionnaires	No.
Artifacts	No.

Time series	No.
Sampling strategy	Convenient sampling and quota sampling for the interview participants (three organizations which offered access to projects).
Data Analysis Process	
Field notes	Yes.
Coding	Yes, coding techniques and checklists were used to connect data with the propositions.
Data displays	Yes.
Flexible and opportunistic process	Yes.
Logical chain of evidence	Yes.
Empirical testing	Yes.
Explanation building	Yes.
Time series analysis	No.
Searching for cross-case patterns.	Yes.
Use of natural controls	Yes; focusing on informants that participated in more than one of the projects.
Quotes (evidence)	Yes.
Project reviews	Yes.
Comparison with extant literature	Yes.

Table 5. Attributes Used to Assess the Case Study (Dibbern et al. 2008; Dubé and Paré 2003).