



## Relationships between IT department culture and agile software development practices: An empirical investigation



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### ABSTRACT

IT department culture has been widely recognized as an important factor that influences the adoption of agile practices. Yet, the research pertaining to the relationship between IT department culture and agile practices usage remains underexplored. This study proposes and tests the relationships between four competing cultural forms and two types of agile practices - social and technical. The findings contribute to the extant literature by integrating the competing values model of culture into the literature on factors affecting agile development at the IT department level.

### 1. Introduction

As business and technology environments become increasingly uncertain and dynamic, agile software development (ASD) has been adopted by information technology (IT) departments in various organizations as a response to the failure of traditional plan-driven waterfall-based approach (Berger, 2007; Larson & Chang, 2016). ASD encompasses agile values and principles, agile methods, and agile practices (Conboy, 2009; Dingsøyr, Nerur, Balijepally, & Moe, 2012). As described by the *Agile Manifesto*, agile values and principles prescribe the overarching philosophies and guidelines underlying ASD. ASD methods such as eXtreme Programming (XP) (Beck, 1999) and Scrum (Schwaber & Beedle, 2002) have emerged as methodological frameworks that organizations can adopt to materialize agile values and principles. ASD methods are composed of various practices (Tripp & Armstrong, 2014). In this paper, we focus on the two types of ASD practices and then investigate how different forms of IT department cultures affect their implementation.

Like the traditional plan driven waterfall-based software development approach, ASD encompasses several technical procedures; however, ASD distinguishes itself from the waterfall approach by being people-centric with drastic emphasis on fast-cycled iterative social interactions between and among different individuals involved in the software development process (Dybå & Dingsøyr, 2009; Hung, Hsu, Su, & Huang, 2014). ASD “adheres to the concept of software development as a continuous and repetitive social and technical engagement and the need to establish daily routines that gradually generate pieces of

functional software. These daily and weekly routines rely on multiple technical and social” practices (Thummadi, Shiv, Berente, & Lyytinen, 2011;). A number of scholars have characterized different ASD practices into technical and social groups (Asnawi, Gravell, & Wills, 2011; Chow & Cao, 2008; McHugh, Conboy, & Lang, 2011; Mnkandla & Dwolatzky, 2007; Robinson & Sharp, 2005b; Treude & Storey, 2009). Drawing on this body of literature, Hummel, Rosenkranz, and Holten, (2015) conducted a qualitative study and proposed a new construct called “*social agile practices*.” They define the social agile practices construct as the ASD practices that facilitate social interaction, collaboration, and direct communication, whereas the *technical agile practices* construct refers to the coding/testing-oriented software engineering practices. In this study, we rely on Hummel et al. (2015) categorization of ASD practices into social and technical types. Moreover, ASD is considered a highly socio-technical process, and thus, it is critical to carefully include both agile-oriented social and technical practices to understand the impact of ASD in detail (Bellini, Pereira, & Becker, 2008; Whitworth & Biddle, 2007).

Additionally, past research has identified IT department culture as a significant barrier to the adoption of agile practices (Cao, Mohan, Xu, & Ramesh, 2009; Fruhling & Tarrell, 2008). Consequently, substantial research has concentrated on proposing the ideal agile culture, which tends to be people-centered and collaborative (Cockburn & Highsmith, 2001; Nerur, Mahapatra, & Mangalaraj, 2005), democratic (Siakas & Siakas, 2007), less formalized and non-hierarchical (Strode, Huff, & Tretiakov, 2009), and has an appropriate reward system (Derby, 2006). However, changing an existing organizational or department-level

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**Table 1**  
Summary of literature related to categorization and descriptions of the Agile practices.

Category (Reference)	ASD Practice	Description
Technical (Maruping et al., 2009)	Unit testing	Programmers continually write unit tests, which must run flawlessly for development to continue (Beck, 2006).
Technical (Maruping et al., 2009)	Continuous Integration	Integrate and build the system many times a day, every time a task is completed (Beck, 2006).
Technical (Maruping et al., 2009)	Refactoring	The design of the system is evolved through transformations of the existing design that keep all the tests running (Beck, 2006).
Technical (Maruping et al., 2009)	Collective Ownership	Every programmer improves any code anywhere in the system at any time if they see the opportunity (Beck, 2006).
Technical (Maruping et al., 2009)	Coding Standards	Programmers write all code in accordance with rules emphasizing communication through the code.
Social (Hummel et al., 2015; Robinson & Sharp, 2005b)	Pair-programming	Two programmers form a team and constantly interact with each other to write all production code at one machine (Beck, 2006).
Social (Hummel et al., 2015; So & Scholl, 2009)	Customer/ Product Owner Role	The person responsible for articulating the product vision. This person actively works with other members to clear any issue pertaining to product features/requirements during systems development. He/she is the voice of the customer/end-user (Sutherland & Schwaber, 2007).
Social (Hummel et al., 2015; So & Scholl, 2009)	Daily Standup	A short meeting (time-boxed to 15 min) that takes place every day at the same time in which individuals give a daily status of their assigned tasks (Sutherland & Schwaber, 2007).
Social (Hummel et al., 2015; So & Scholl, 2009)	Retrospectives	A meeting that is used to discuss questions such as "what went wrong" and "what went well" in the past development cycle. It helps identify "what could be improved" in future development cycles (Sutherland & Schwaber, 2007).

culture is a challenging task (Iversen & Ngwenyama, 2006). Moreover, if at all the culture changes, it will be dependent on the existing organizational or department-level culture (Barney, 1986). While it is important to understand what the elements of an ideal agile culture are, even more important is to understand how existing IT department culture will affect the usage of ASD practices (Iivari & Iivari, 2011; Tolfo, Wazlawick, Ferreira, & Forcellini, 2011). Therefore, the primary research question that we examine in this study is: *How does IT department culture affect the use of social and technical agile practices?*

Our focus in the remainder of the paper is to explore the literature that informs our theory development and testing, the methods we use to collect and examine our data, and to examine and discuss the results of our investigation. We conclude the paper with implications of our research for theory and practice, limitations of the study, and directions for future research.

## 2. Theoretical background

### 2.1. ASD practices

Agile values and principles, as described by the Agile Manifesto, prescribe the overarching philosophies and guidelines underlying ASD. ASD methods are composed of various ASD practices. For example, XP is composed of such ASD practices as refactoring, collective ownership, and continuous integration (Beck, 1999). Since different agile methods were proposed out of particular circumstances with different and sometimes contradictory practices (Tripp & Armstrong, 2014), most organizations adopt a mix of ASD practices derived from two or more ASD methodologies (Conboy & Fitzgerald, 2010; Stavru, 2014; VersionOne, 2015). In this paper, we focus on ASD practices, which refer to specific techniques or actions taken by IT department in their routines of software development (Hummel et al., 2015).

Over the years, several scholars have suggested classifying ASD practices into technical and social types. For instance, Chow and Cao (2008) label software engineering-oriented practices, such as well-defined coding standards, up front and rigorous refactoring activities, as technical and practices fostering customer involvement and team motivation as social. Some suggest that, while several ASD practices are used during software development, some are focused on writing source code and test scenarios, whereas others facilitate communication and knowledge sharing among individuals (McHugh et al., 2011; Treude &

Storey, 2009). Robinson and Sharp (2005b) assert that some ASD practices tend to be more socially-oriented than technically-oriented. Similarly, Mnkandla and Dwolatzky (2007) contend that ASD practices that relate to software coding are technical, while those relate to people issues are social. Jyothi and Rao (2011) suggest classifying the eleven agile principles of the agile manifesto in terms of technical and social dimensions. Vavpotic and Bajec (2009) suggest that, in order to understand the benefits of using a software development methodology, it is important to view software development through the lens of technically and socially-oriented ASD practices because focusing on either one will result in an incomplete evaluation of software development methodologies. While few studies have also used the label of project management practices in lieu social practices, (Tripp & Armstrong, 2014), the label project management, in general, refers to hierarchical planning, monitoring, and control of activities and resources in the academic literature (Hallinger & Snidvongs, 2008)

To summarize, there is a high degree of agreement among the scholars pertaining to the categorization of ASD practices into social and technical types (Corvera Charaf, Rosenkranz, & Holten, 2013; Diegmann & Rosenkranz, 2016; Ozcan-Top & Demirörs, 2013). Using this stream of literature as a theoretical basis, Hummel et al. (2015), "recognizing the importance of social interactions, social behavior, and communication in the ISD [information systems development] process," proposed the construct of social agile practices to describe a subset of ASD practices that foster interactions, collaboration, and direct communication among individuals (p. 280). By comparison, the subset of ASD practices that emphasizes the software engineering-oriented aspects of software development is defined by the technical agile practices construct.

We utilize the same definitions of the social and technical agile practices constructs in this study at the IT department-level, and specifically focus on six XP practices (unit testing, continuous integration, refactoring, collective ownership, coding standards, and pair-programming) and three widely-adopted Scrum practices (product owner, daily standups, and retrospectives). We choose these nine practices as they are not only widely used in industry, but also in the academic literature (Maruping, Venkatesh, & Agarwal, 2009; McHugh et al., 2011; So & Scholl, 2009). Following a number of studies discussed previously, we classified continuous integration, collective ownership, unit testing, refactoring, and coding standards as technical agile practices (Maruping et al., 2009), while daily-stand-ups, retrospectives, and

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