Global Agile Team Configuration

Jason H. Sharp
jsharp@tarleton.edu
Computer Information Systems
Tarleton State University
Stephenville, TX 76402, USA

Sherry D. Ryan
Sherry.Ryan@unt.edu
Information Technology & Decision Sciences
University of North Texas
Denton, TX 76203, USA

Abstract

Agile methods were created to address many of the challenges typically associated with software development projects. The question has been debated as to whether agile methods are applicable in global settings because a key agile principle suggests teams need to be collocated. Some current research has demonstrated that globally distributed agile teams are possible, at least in some situations. Therefore, we pose the following research question: How can a productive agile team be configured in globally distributed environment? Drawing upon configurational theory, the software agility literature, virtualness concepts, and the work group design research, this paper constructs a framework consisting of three major dimensions, agility, virtualness, and structure. We propose a configurational pattern for global agile teams by taking each of the twelve principles of the Agile Manifesto and describe its intersection with each of the three major dimensions of the framework. Our primary argument is that eight agile principles are especially relevant for the configuration of global agile teams, while the four remaining principles are either unsupported by previous literature or do not constitute unique considerations. Overall, this paper contributes to the information systems field by providing a framework for examining the pertinent elements related to a successful global agile team configuration in respect to the twelve principles of the Agile Manifesto.

Keywords: global agile teams, agile methods, global software development, framework, team configuration

1. INTRODUCTION

In recent years the use of agile software development methods, which describe ways of producing software in a lighter, quicker, more people-centered way, has been recommended to alleviate the traditional challenges associated with software development (Abrahamsson, Warsta, Sippon, & Ronkainen, 2003). Based upon the fact that many organizations have already been using distributed teams for some time, and in many cases globally distributed, there is an increasing stream of research examining the concept of distributed agile development (e.g., Agerfalk & Fitzgerald, 2006; Holmstrom, Fitzgerald, Agerfalk, & Conchuir, 2006; Lee, Delone, & Espinosa, 2006; Lee & Xia, 2010; Ramesh, Cao, Mohan, & Xu, 2006; Sarker, Munson, Sarker, & Chakraborty, 2009; Sarker & Sarker, 2009).

According to the Agile Manifesto, a fundamental principle of agile methods is the efficacy of collocated teams in order to enable daily, face-to-face (FTF) interaction between stakeholders (Fowler & Highsmith, 2001). Considering that

within the context of global software development, virtual team members may never meet in person a potential dilemma exists for organizations that are considering the use of agile methods in a distributed environment (Gibson & Cohen, 2003). Fortunately, for such organizations a growing stream of research suggests that, although it is sometimes difficult and takes great care, it is possible through the modification of the agile method to the distributed setting (Agerfalk & Fitzgerald, 2006; Fitzgerald, Hartnett, & Conboy, 2006; Holmstrom et al., 2006; Kircher, Prashant, Corsaro, & Levine, 2001; Sarker & Sarker, 2009; Sarker et al., 2009; Schummer & Schummer, 2001; Xiaohu, Bin, Zhijun & Maddineni, 2004).

2. CONFIGURING GLOBAL AGILE TEAMS FRAMEWORK

Team configuration in global settings is a complex phenomenon. While it is true that globally distributed teams encounter many of the same challenges as collocated teams, these are often exacerbated by physical distance and cultural issues (Komi-Sirvio & Tihinen, 2005; Shachaf, 2008). Thus, the actual configuration of agile teams in globally distributed environments appears to be a significant area of research that has currently received minimal attention. Drawing upon configurational theory, the software agility literature, work group design research, and team virtualness concepts, we propose that it is possible to successfully configure a global agile software development team, but that there are issues that must be well thought-out and that make this particular type of team different from other global teams based upon the use of an agile methodology.

A configuration may "denote any multidimensional constellation of conceptually distinct characteristics that commonly occur together" (Meyer, Tsui, & Hinnings, 1993, p. 1175). In other words, a configuration is a pattern that describes an entity. Although a considerable amount of work on configurations has been conducted at the organizational level (Miles & Snow, 1978; Mintzberg, 1979, 1983), much less has been done at the group level. A team is representative of a group level configuration.

Therefore, we pose the following research question: How can a productive agile team be configured in a globally distributed environment? To address this question we review the literature and construct a framework consisting of three dimensions: team agility, virtualness, and structure as illustrated in Fig. 1 (see Appendix A). Each of these major dimensions are discussed in the sections below, followed by a discussion of their intersections. This paper significantly contributes to the information systems field by providing a distinct framework by which future research investigating globally distributed agile teams can build. The intersection of the framework's dimensions highlights important areas that should be considered when configuring a global agile team.

Team Agility

The first major dimension of our framework is team agility. The term agile methods grew out of a meeting of scholars and practitioners in 2001 who were interested in establishing common ground among various development methodologies originating from the 1990s. The outcome of this meeting was a statement entitled the "Manifesto for Agile Software Development" which summarized the core values as well as established a set of twelve guiding principles. The Agile Manifesto outlines twelve specific principles that have been established to guide agile development, see Table 1 (Appendix B).

These principles emphasize the need for early and continuous delivery of software, openness to changing requirements, delivering working software on a frequent basis, strong interaction between stakeholders, supporting and motivating team members, promoting sustainable development, fostering technical excellence, and regular feedback. Proponents of agile methods have consistently argued that in order for agile methods to be successful they must be implemented as a whole (Beck and Andres, 2000). However, some research suggests that agile methods can be tailored (e.g., Fitzgerald et al., 2006; Kircher et al., 2001; Lee et al., 2006; Schummer & Schummer, 2001; Xiaohu et al., 2004). This tailoring may allow for teams to adhere to fewer values, principles, and practices and still maintain a high level of agility.

Team Virtualness

The second major dimension of our framework is team virtualness. With the rise in the globalization of business and the advancement of information and communication technologies, organizations are increasingly adopting global virtual software development as a strategy to meet the budgetary and time constraints of software projects. Bell and Kozlowski (2002) proposed a typology of virtual teams that con-

sisted of boundary spanning, temporal distribution, life cycles and member roles. Boundary spanning indicates that virtual teams can cross functional, organizational, and cultural boundaries. Temporal distribution denotes that a virtual team is distributed across time. Virtual team members may be collocated in time, separated by only a few hours, or separated by many hours. Members may also be temporally synchronized, e.g., located in different time zones, but are still working off of the same time reference. The life cycle dimension suggests that virtual teams may not follow the traditional life cycle that occurs in traditional teams. Finally, the member roles dimension implies that members may participate in multiple roles within a team.

As shown in Fig. 1 (see Appendix A), we did not include these later two dimensions in our framework because we think they overlap with, and are more appropriately included in, the third dimension in our framework, team structure. We argue that these characteristics are directly affected by the team structure, which is one of the reasons it is so important to carefully consider its design (Hackman, 2002).

Team Structure

The third major dimension of our framework is team structure. Meyer et al. (1993) suggested that work group design represents a possible group level configurational approach (Hackman, 2002; Hackman & Oldham, 1980; Hackman & Walton, 1986). Although work group design research addresses teams in general, "the structural conditions that foster effectiveness of face-to-face teams are just as critical for virtual teams – but with one caveat: *it is much harder to create those conditions in virtual teams*" (Hackman, 2002, p. 131). In sum, Powell, Piccoli, and Ives (2004,) stated, "we believe that investigation of team structure in the virtual environment holds significant promise for research and practice because it represents perhaps the most controllable and influential aspect of virtual team design" (p. 6). As a dimension of the proposed framework, team structure includes the sub-dimensions of task design, core norms of conduct, team composition, and team processes, each of which is briefly described below.

Task design deals with the construction of the work itself. Team structure is dependent on the work performed (Prasad & Akhilesh, 2002). According to Powell et al. (2004), significant attention has been paid to the design of virtual team interaction, but much less attention has been given to the design of the work unit itself. Core norms of conduct indicate the acceptable and unacceptable behaviors of the team (Hackman, 2002).

An important element of virtual team design is the establishment of a shared set of norms which direct the individual and corporate behavior of members (Sarker, Lau, & Sahay, 2001; Suchan & Hayzak, 2001). It is important that each team member positively internalizes this set of rules and in essence "buys-in" to their use (Sepulveda, 2003).

Team composition addresses the elements of size, mix, interpersonal skills, and task-related knowledge and skill. Hackman (2002) argued that determining the size of the team is largely dependent on the complexity of the task and advocated having as few team members as possible to accomplish the task. Suchan and Hayzak (2001) argued that virtual team members must possess excellent interpersonal and conflict management skills as well as task-related knowledge and skills.

Prasad and Akhilesh (2002) suggested that team processes are also an important structural element and consist of several considerations: (1) the mechanism for making decisions in terms of its centralization and formality, (2) the degree of information sharing between the members of the team and their participation in the long-range planning of projects, (3) the modes of control and communication and coordination, and (4) the degree of commonality in work process and technology infrastructure.

Summary of Framework Dimensions

Overall the choice to include these three dimensions into our framework was based upon a thorough review of the literature in regard to the agile methodology, virtualness, and team design. In terms of agility, the framework incorporates the principles of the Agile Manifesto. The typology set forth by Bell and Kozlowski (2002) appears to encapsulate the primary elements pertaining to the virtualness of globally distributed teams as described in the virtual team literature. For example, Prasad and Akhilesh (2002) emphasized that an important contextual aspect of a virtual team was its degree of virtualness which included such characteristics as the measure of geographically dispersion and the temporal nature of the team. Lu, Watson-Manheim, Chudoba, and Wynn (2006) used the term team distribution to de-

fine the virtualness of the team, stating that it is, "the degree to which people work on teams that have people distributed over different geographies and time zones, relying upon collaboration technologies" (p. 6).

In regard to team structure, the dimensions provided by Hackman (2002) and Prasad and Akhilesh (2002) cover a broad range of subdimensions that relate to all teams, but also to virtual teams in particular. Prasad and Akhilesh (2002) addressed the characteristic of team composition and membership directly as it related to virtual teams suggesting its importance in any definition of a virtual team. Kirkman, Rosen, Gibson, Tesluk, and McPherson (2002) suggested that identifying virtual team members who have a healthy balance of technical and interpersonal skills as one of the primary challenges related to virtual team success. Finally, in terms of team processes, Lurey and Raisinghani (2001) found that there was a strong relationship between the team's processes and team performance and team member satisfaction.

In an effort to bring further clarity to our choice of dimensions for the proposed framework we examine two recent studies based upon actual data collected among global agile teams. A brief summary of each study is provided below along with its relevance to the dimensions of our proposed framework.

Sarker and Sarker (2009) proposed three major categories of agility which may potentially affect the successful configuration of global agile teams: (1) resource agility, (2) process agility, and (3) linkage agility. Resource agility includes people-based and technology based agility. In regard to these subcategories components related to team configuration include the ability to rapidly ramp-up/down a team, interchangeability of roles, reconfigurability of the team, distributed decision-making, and comparable and compatible ICT infrastructure at each location. Process agility includes methodology-based, temporal-bridge based, and environmental-awareness based agility. Components potentially affecting team configuration from these subcategories include: carefully managed adoption of agile methodologies in distributed context, capability to transition work seamlessly across many time zones, and capability to bridge time differences through synchronous meetings. Linkage agility includes cultural-mutuality based and communicative-relationship based agility. Related components to team configuration include capability to maintain continuous awareness of distributed colleagues and their work, maturity of the interlocation communicative relationships, and close collaboration among clients and distributed team members.

As can be deduced by an examination of the components of each of these subcategories of agility, many of the same themes emerge when compared to the dimensions of the framework presented in this paper. Structure addresses the components of team ramping and reconfigurability of the team. Virtualness deals with interchangeability of roles and the implementation of ICT, working across multiple time zones and bridging these time differences through ICT which allows for synchronous communication. Finally, agility relates to the adoption and management of agile methodologies in a distributed context.

Lee and Xia (2010) examined the software team characteristics of team autonomy and team diversity within a larger research context. Team autonomy was defined as "the extent to which the software team is empowered with authority and control in making decisions to carry out a project", while team diversity was defined as "the extent to which team members are different in terms of their functional backgrounds, skills, expertise, and work experience" (p. 88-89). These particular characteristics are directly related to the structure dimensions of our proposed framework which includes the subdimensions of task design and team composition which specifically address knowledge and task related skills.

3. CONFIGURATIONAL PATTERN: INTERSECTION OF FRAMEWORK DIMENSIONS

According to Bose (2008) the Agile Manifesto is a "well accepted benchmark to judge agile projects" (p. 626). In a review of the literature he identified twelve case studies on the successful implementation of distributed agile software projects. He then analyzed and synthesized the findings from the perspective of the values and principles of the Agile Manifesto. Bose indicated that in the case studies examined, 11 of the 12 principles of the Agile Manifesto were evidenced to some degree. The result of his analysis was that not all principles enumerated in the Agile Manifesto were considered to be important. Subsequently, in this section we propose a configurational pattern for global agile teams by taking each principle

of the Agile Manifesto and describe its intersection with the other dimensions and applicable subdimensions of our framework as shown in Table 2 (see Appendix C). We argue that eight agile principles are especially relevant for consideration of global agile teams and that the remaining four principles are either unsupported by previous literature or do not engender unique considerations for globally distributed teams. Where differences exist between Bose's analysis and our own, in regard to the inclusion or exclusion of specific principles, a justification is provided under that principle.

Principle 1 - Our highest priority is to satisfy the customer through early and continuous delivery of valuable software

Satisfying the customer is more challenging in a global, distributed environment because of both boundary spanning and temporal distribution challenges. In terms of boundary spanning issues, differences in national cultures pose challenges to conveying information in which the meaning and priorities of that information are shared. Culture can have a great impact on how individuals interpret and react to various situations (Kotlarsky & Oshri, 2005). Factors such as the need for structure, attitude toward organizational hierarchy, sense of time, language barriers, and overall attitude toward international development all come into play in some way (Battin, Crocker, Kreidler, & Subramanian, 2001; Herbsleb & Moitra, 2001).

The core norms of the team must address these cultural differences to help alleviate misunderstandings which can lead to low customer satisfaction and hurt feelings among team members. Cultural training at the project's inception can aid in the alignment of cultural frames of reference. Temporal distribution also leads to difficulty in requirements engineering and can potentially impact the communication processes in which timely feedback is received, especially when the timeframe for development is short and the time zone difference is large.

As development teams seek customer satisfaction through early and continuous delivery of valuable software, all four structural configurational characteristics should be considered. First, team processes should be designed so that there is regular feedback, both from team members and customers. The agile practice of short iterations requires that the technology tools be available both to the developers as well as the customers so that prototypes can be evaluated. Team composition should also be carefully considered. Team members must be selected with the appropriate type of interpersonal skills. Miscommunication and erroneous interpretation of requirements can occur when team members have poor communication skills or are inexperienced, especially in a globally distributed team (Hanisch & Corbitt, 2007).

Finally, task design should be configured so that developers have meaningful challenges and regular assessments of their performance. Dividing tasks among developers in multiple locations can be a complex. However, to ensure customer satisfaction with the development effort, and completion of tasks in a timely manner, planning in this regard is imperative. In sum, we determined that this principle is impacted by both boundary spanning and temporal distribution, and that the structural configuration characteristics included team processes, core norms, team composition, and task design.

Principle 2 - Business people and developers must work together daily throughout the project

Temporal distribution makes it challenging for business people and developers to work together on a daily basis (Hanisch & Corbitt, 2007). It is easier if at least some of the team members are on time schedules that are not polar opposites. This implies that ideally, at least part of the team should be in time zones where at least some of the standard business day overlaps. Team processes, in terms of when and how to communicate, are critical (Rennecker & Goodwin, 2005; Ocker & Fjermestad, 2008). Even within a global agile team, daily (or periodic) stand-up meetings can be implemented through the use of synchronous, visual technologies such as videoconferencing. Establishment of core norms such as how long the stand-up meeting should last, what information should be discussed, and who may participate in the discussion are important within a global context.

In regard to team composition members should be chosen that have a bent for collaboration, which is critical for business people and developers as they work together as stated by this principle. Similar to collocated agile teams, it is also recommended that the size of global agile teams be kept as small as possible based upon the scope and complexity of the project. Due to the distributed nature of the team, con-

figuring a team that is too large may decrease the level of communication and coordination. This may be evidenced in the daily stand-up meetings by lack of involvement, loss of focus, or simply by the meeting going on for too long. Overall, we found that the principle was impacted by temporal distribution specifically in the structural areas of team processes, core norms, and team composition.

Principle 3 - The most efficient and effective method of conveying information to and within a development team is face-to-face conversation

It is widely accepted that cultural differences, an element of boundary spanning, present a significant challenge to global software development and that those differences can be exacerbated in a non-face-to-face environment (e.g., Carmel, 1999; Damian & Moitra, 2006; Evaristo, Scudder, Desouza, & Sato, 2004; Herbsleb & Moitra, 2001). Cultural differences and lack of shared meaning (Carmel, 1999; Hanisch & Corbitt, 2007; Herbsleb & Moitra, 2001) are common problems. Fortunately, a study by Shachaf (2008) indicated that information and communications technologies "mitigated the negative impact of cultural diversity on team effectiveness while supporting the positive impact" (p. 139).

In a study conducted by Herbsleb and Mockus (2003) it was found that work distributed across sites appears to take two and one-half times longer than similar projects where the entirety of the work is done in a collocated environment. The study showed that that size, diffusion, and number of people were all directly related to the delay. Interestingly, however, there was no direct link between the amount of delay and the distributed nature of the work. This suggested that the number of people working on the project had a more significant influence on the amount of delay than the geographic distance. There is evidence that suggested that as a team grows in size, team productivity actually decreases rather than increases (Hackman, 2002). Therefore, as stated earlier, keeping the team size small is recommended.

Configuring team processes that utilize technology to compensate for lack of FTF efficiencies is critical, but can also be a source of problems. The loss of "communication richness" is a significant problem often caused by the physical distance and time zone differences (Evaristo et al., 2004). As such, it is extremely important that protocols (core norms) be established for facilitating both official and informal communication. By using such technologies the team can implement communication-based agile practices such as the daily stand-up, iteration planning, iteration demos, iteration retrospectives, and pair programming. Boundary spanning and temporal distribution impacted this principle with the specific structural configuration characteristics of team processes, core norms, and team composition.

Principle 4 - Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done

Trust is a key component, which can be more difficult with temporal distribution issues in which team members have never had FTF interaction (Hanisch, Thanasankit, & Corbitt, 2001; Mitchell & Zigurs, 2009). A major concern is choosing team members that are motivated individuals. While this is not unique to global distributed environments, it appears more critical because motivation would not come from physical presence of having other team members "looking over one's shoulder."

The task design must facilitate collective internal work motivation. The tasks should be meaningful to the team member who is assigned the task. This means that the tasks should be significant and challenging. Strategically, the ideal arrangement would, to a large degree, allow each site to work independently while still fostering flexible and effective communication (Herbsleb & Moitra, 2001). Another aspect of task design is ensuring that team members clearly understand how their part of the project fits into the larger project scheme. While team members should be "self-starters", and should be given the latitude and the resources to accomplish the tasks assigned, they must also be able to work well with others (Hackman, 2002).

The concepts of short iterations and small releases are important to the design of the tasks and relate to the areas of meaningfulness, autonomy, and feedback. In regard to meaningfulness members are able to see the result of their work within a short period of time, such as a matter of weeks rather than months, which may promote a stronger sense accomplishment and thus increase motivation. Allowing the members a high to moderate level of autonomy within each iteration empowers them to apply the practices they deem most

suitable to meet the requirements of the iteration as well as employ personal creativity to ensure the needed requirements are complete by the end of the iteration. Finally, regular assessments provided during and after each iteration (i.e., stand-up meeting, iteration retrospective), in weeks rather than months, enables members to make necessary changes and respond more quickly to customer requests. In sum it was determined that temporal distribution impacted this principle with the identification of task design as a structural configuration characteristic.

Principle 5 - The best architectures, requirements, and designs emerge from self-organizing teams

Self-organization is more difficult in a virtual, globally distributed environment in which members derive rules of behavior and come up with a self-organizing team hierarchy and values. Two of the critical areas in which boundary spanning and temporal distribution create difficulty are coordination and control. Coordination may be defined as the integration of "each task with each organizational unit, so the unit contributes to the overall objective"; whereas, "control is the process of adhering to goals, policies, standards, or quality levels"; and "communication is a mediating factor affecting both coordination and control" (Carmel & Agarwal, 2001, p. 23). Team processes which establish effective communication modes serve as a crucial intermediary between coordination and control in globally distributed environments. When establishing these team processes, organizations must evaluate the trade-offs between the advantages and disadvantages of synchronous and asynchronous communication.

Finally, integrating globally distributed teams into a coherent team and instilling a sense of "teamness" is a challenging endeavor (Battin et al., 2001; Carmel, 1999; Herbsleb & Mockus, 2003). Allowing the team to formulate its own set of core norms rather than strictly imposing organizational policy and procedure may contribute to the development of this sense of "teamness". Due to inherent challenges of communication, culture, and conflict within a distributed team, the freedom to develop strategies for addressing these types of issues helps to build cohesion and oneness. Overall, boundary spanning and temporal distribution impacted this principle with team processes and core norms identified under structural configuration characteristics.

Principle 6 - At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly

The existing literature identifies regular feedback as a crucial aspect of a successful global agile team configuration (e.g., Fowler, 2006; Layman, Williams, Damian, & Bures, 2006; Nisar & Hameed, 2004; Ramesh et al., 2006; Sepulveda, 2003; Yap, 2005). Multiple agile practices such as daily stand-up meetings, iteration planning sessions, iteration demos, and iteration retrospectives can potentially contribute to the feedback loop in a very positive manner by providing the members with a constant stream of interaction with their colleagues and allowing for consistent feedback on how the project is progressing. Because of the emphasis on regular and effective communication in agile methodologies regular feedback can greatly enhance the agility of the team. A primary benefit is that global agile teams are not communicating every few weeks, but more likely every day.

While it is true that the use of multiple ICT can help facilitate these practices for providing a mechanism for reflection and adjustment, the configuration of the team must again take into consideration the issue of temporal distribution. When there is a lack of overlapping work hours due to time zone differences the use of ICT is greatly hindered. If there is not someone on the other end of the communication to receive it, these technologies become useless for synchronous communication and cannot remedy the challenge of significant temporal distribution (Espinosa & Pickering, 2006). This suggests that teams should not simply be configured based upon the lowest cost locations, but also by considering the time zone differences. Moreover, by emphasizing the practices of short iterations and small releases the team is able to see each of the smaller pieces as they come along as providing a sense of the overall project purpose and goal, i.e., the "big picture". This principle was impacted only by temporal distribution and specifically team processes and core norms for the structural configuration characteristics.

Principle 7 - Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale

Even within global agile teams, iterations can be scheduled in terms of weeks rather than in months and allow the customer to take an active and regular part in the design of the software. Through the use of multiple types of ICT, the customer can then see the progress of the project early and often and decide whether or not changes need to be made. Similarly, with small releases, the customer can actually see how parts of the project are functioning much sooner than with a traditional waterfall approach. Short iterations, small releases, and iteration demos have the potential to keep the customer satisfied during the entire project development lifecycle due to their regular involvement and ability to track the progress from requirements gathering to implementation. By carefully structuring the task design and the team processes, the team increases its ability to deliver software on a shorter timescale, thus decreasing the boundaries between it and its customer. Overall, this principle was impacted only by boundary spanning with team processes and task design being identified as structural configuration characteristics.

Principle 8 - Simplicity—the art of maximizing the amount of work not done—is essential

Although this principle received little support in Bose's (2008) study in that only one case supported it, while the other cases indicated insufficient or no information, we argue that it should be included for consideration when global teams are configured. We propose that if the simplicity principle were enacted, there would be less boundary and temporal issues because there would be less work done and therefore fewer misunderstandings due to cultural issues and less work to coordinate across multiple time zones. To sum up, this principle was impacted by both boundary spanning and temporal distribution with the structural configuration characteristics of team processes, core norms, and task design.

Principle 9 - Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage

Bose (2008) found that this principle was not evidenced in any of the case studies, either because of insufficient or no information. We therefore omit it from our framework, but suggest that future empirical research validate its omission.

Principle 10 - Working software is the primary measure of progress.

Principle 11 - Continuous attention to technical excellence and good design enhances agility.

Principle 12 - Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely

Although Bose (2008) found at least some support for principles 10-12 we argue that they are true for collocated as well globally distributed teams. While these principles are important to successful implementation, they are broad in scope. For example, principle 10 states that working software is the primary measure of progress. If agile principles were followed, this principle would be true in both a local-only environment as well as in a globally distributed environment; likewise, for principles 11 and 12.

4. CONCLUSION AND FUTURE RESEARCH

Based upon the literature exploring agility, virtualness, and team structure it is the belief of the authors that agile methodologies can be successfully applied in global software development projects. If research on the configuration of global agile teams is not conducted, researchers and practitioners alike will not have a clear understanding if there are truly significant differences between how agile teams and non-agile teams are designed in globally distributed settings.

As such, we believe that this paper contributes to the information systems field by providing a framework based on extant literature that indicates these three major dimensions are appropriate and provides practical insights for challenging the way organizations think about configuring global agile teams. In this way, this framework can be used to potentially alter the way in which team structuring decisions are made. Furthermore, our paper shows that particular intersections of the framework are especially important when configuring agile teams in a global environment. As of this time no known research framework exists which incorporates these three dimensions.

As organizations become more attentive to leveraging global assets, the topic of global development will continue to be an area of interest and the utilization of global agile teams has the potential to significantly impact the

field of software development. We do recognize, however, that it is possible that other dimensions may exist that we have not included in our framework.

Future empirical research should explore these dimensions, subdimensions, and the resulting configurational interactions. Case study research would be appropriate to provide rich descriptive data about best practices, pitfalls and successes experienced by organizations that have already begun to venture down this path. In conclusion, our hope is that this framework will serve as a building block for further research in this important area and will be of to organizations and academicians alike.

5. REFERENCES

Abrahamson, P., Warsta, J., Sippon, S. T., & Ronkainen, J. (2003). New directions on agile methods: A Comparative Analysis. Proceedings of the 25th International Conference on Software Engineering, 244-254.

Agerfalk, P. J., & Fitzgerald, B. (2006). Flexible and distributed software processes: Old petunias in new bowls?. *Communications of the ACM*, 49(10), 27-34.

Battin, R. D., Crocker, R., Kreidler, J., & Subramanian, K. (2001). Leveraging resources in global software development. *IEEE Software*, 18(2), 70-77.

Beck, K., & Andres, C. (2000). Extreme programming explained: Embrace change. Addison-Wesley: Boston, MA.

Bell, B. S., & Kozlowski, S. W. J. (2002). A typology of virtual teams: Implications for effective Leadership. *Group & Organization Management*, 27(1) 14-49.

Bose, I. (2008). Lessons learned from distributed agile software projects: A case-based analysis. C*ommunications of the Association for Information Systems*, 23(34), 619-632.

Carmel, E. (1999). Global software teams: Collaborating across borders and time zones. Prentice-Hall: Upper Saddle River, NJ.

Carmel, E., & Agarwal, R. (2001). Tactical approaches for alleviating distance in global software development. *IEEE Software*, 18(2), 22-29.

Damian, D., & Moitra, D. (2006). Global software development: How far have we come? *IEEE Software*, 23(5), 17-19.

Espinosa, J. A., & Pickering, C. (2006). The effect of time separation on coordination processes and outcomes: a case study. Proceedings of the 39th Hawaii International Conference on System Sciences, pp. 1-10.

Evaristo, R. J., Scudder, R., & Desouza, K.C. (2004). A dimensional analysis of geographically distributed project teams: A case study. *Journal of Engineering Technology Management*, 21(3), 175-189.

Fitzgerald, B., Hartnett, G., & Conboy, K. (2006). Customising agile methods to software practices at Intel Shannon. *European Journal of Information Systems*, 15(2), 200-213.

Fowler, M. (2006). Using agile software process with offshore development. Retrieved from http://martinfowler.com/articles/agileOffshore.html

Fowler, M., & Highsmith, J. (2001). The agile manifesto. *Agilemanifesto.org*. Retrieved April 27, 2006, from http://www.agilemanifesto.org

Gibson, C. B., & Cohen, S. G. (2003). In the beginning: Introduction and framework. In C. B Gibson and S. G. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness*, Jossey-Bass: San Francisco, CA.

Hackman, J. R. (2002). Leading teams: Setting the stage for great performances. Harvard Business School Press: Boston, MA.

Hackman, J. R., & Walton, R. E. (1986). Leading groups in organizations. In P. S. Goodman (Ed.), *Designing effective work groups*. Jossey-Bass: San Francisco, CA.

Hackman, J. R., & Oldham, G. R. (1980). *Work redesign*. Addison-Wesley: Reading, MA.

Hanisch, J., & Corbitt, B. (2007). Impediments to requirements engineering during global Software development. *European Journal of Information Systems*, 16(6), 793-805.

Hanisch, J., Thanasankit, T., & Corbitt, B. (2001). Exploring the cultural and social impacts on the requirements engineering process - highlighting some problems challenging virtual team relationships with

clients. *Journal of Systems and Information Technology*, 5(2), 1-19.

Herbsleb, J. D., & Mockus, A. (2003). An empirical study of speed and communication in globally distributed software development. *IEEE Transactions on Software Engineering*, 29(6), 481-494.

Herbsleb, J. D., & Moitra, D. (2001). Global software development. *IEEE Software*, 18(2), 16-20.

Holmstrom, H., Fitzgerald, B., Agerfalk, P. J., & Conchuir, E. O. (2006). Agile practices reduce distance in global software development. *Information Systems Management*, 23(3), 7-18.

Kircher, M., Prashant, J., Corsaro, A., & Levine, D. (2001). Distributed eXtreme programming. In M. Marchesi, G. Succi, D. Wells, L. Williams, J.D. Wells (Eds.), *Extreme Programming Perspectives*. Addison-Wesley: Reading, MA. Retrieved September 18, 2006, from http://www.kircher-schwaiger.de/michael/publications/xp2001.pdf

Kirkman, B. L., Rosen, B., Gibson, C. B., Tesluk, P., & McPherson, S. (2002). Five challenges to virtual team success: Lessons from Sabre, Inc. *Academy of Management Executive*, 16(3), 67-79.

Kotlarsky, J., & Oshri, I. (2005). Social ties, knowledge sharing and successful collaboration in globally distributed system development projects. *European Journal of Information Systems*, 14(1), 37-48.

Komi-Sirvio, S., & Tihinen, M. (2005). Lessons learned by participants of distributed software development. *Knowledge and Process Management*, 12(2), 108-122.

Layman, L., Williams, L., Damian, D., & Bures, H. (2006). Essential communication practices for Extreme Programming in a global software development team. *Information and Software Technology*, 48(9), 781-794.

Lee, G., Delone, W., & Espinosa, J. A. (2006). Ambidextrous coping strategies in globally distributed software development projects. *Communications of the ACM*, 49(10), 35-40.

Lee, G., & Xia, W. (2010). Toward agile: An integrated analysis of quantitative and qualitative field data on software development agility. *MIS Quarterly*, 34(1), 87-114.

Lu, M., Watson-Manheim, M. B., Chudoba, K., & Wynn, E. (2006). How does virtuality affect team performance in a global organization? Understanding the impact of variety of practices. *Journal of Global Information Technology Management*, 9(1), 4-23.

Lurey, J. S., & Raisinghani, M. S. (2001). An empirical study of best practices in virtual teams. *Information & Management*, 38(8), 523-544.

Meyer, A. D., Tsui, A. S., & Hinings, C. R. (1993). Configurational approaches to organizational analysis. *Academy of Management Journal*, 36(6), 1175-1195.

Miles, R. E., & Snow, C. C. (1978). *Organizational strategy, structure, and process*. New York: McGraw-Hill.

Mintzberg, H. T. (1983). Structure in fives: Designing effective organizations. Prentice-Hall: Englewood Cliffs, NJ.

Mintzberg, H. T. (1979). The structuring of organizations. Prentice-Hall: Englewood Cliffs, NJ.

Mitchell, A., & Zigurs, I. (2009). Trust in virtual teams: Solved or still a mystery? *The DATA BASE for Advances in Information Systems*, 40(3), 61-83.

Nisar, M. F., & Hameed, T. (2004). Agile methods handling offshore software development issues. Proceedings of the 8th International Multitopic Conference, pp. 417-422.

Ocker, R. J., & Fjermestad, J. (2008). Communication differences in virtual design teams: Findings from a multi-method analysis of high and low performing experimental teams. *The DATA BASE for Advances in Information Systems*, 39(1), 51-67.

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and directions for future research. *The DATA BASE for Advances in Information Systems*, 35(1), 6-36.

Prasad, K., & Akhilesh, K. B. (2002). Global virtual teams: What impacts their design and Performance? *Team Performance Management*, 8(5/6), 102-112.

Ramesh, B., Cao, L., Mohan, K., & Xu, P. (2006). Can distributed software development be agile? *Communications of the ACM*, 49(10), 41-46.

Rennecker, J., & Goodwin, L. (2005). Delays and interruptions: A self-perpetuating paradox of communication and technology use. *Information and Organization*, 15, 247-266.

Sarker, S., Lau, F., & Sahay, S. (2001). Using an adapted grounded theory approach for inductive theory building about virtual team development. *DATA BASE for Advances in Information Systems*, 32(1), 38-56.

Sarker, S., Munson, C. L., Sarker, S., & Chakraborty, S. (2009). Assessing the relative contribution of the facets of agility to distributed systems development success: An Analytic Hierarchy Process approach. *Journal of Information Systems*, 18, pp. 285-299.

Sarker, S., & Sarker, S. (2009). Exploring agility in distributed information systems development teams: An interpretive study in an offshoring context. *Information Systems Research*, 20(3), 440-461.

Sepulveda, C. (2003). *Agile development and remote teams: Learning to love the phone*. Proceedings of the Agile Development Conference, pp. 1-6.Schummer, T., & Schummer, J. (2001). Support for distributed teams in eXtreme programming. In G. Succi, & M. Marchesi (Eds.), *Extreme Programming Examined*, Addison-Wesley: Reading, MA.

Shachaf, P. (2008). Cultural diversity and information and communication technology impacts on global virtual teams: An exploratory study. *Information & Management*, (45)2, 131-142.

Suchan, J., & Hayzak, G. (2001). The communication characteristics of virtual teams: A case study. *IEEE Transactions on Professional Communication*, 44(3) 174-186.

Xiaohu, Y., Bin, X., Zhijun, X. H., & Maddineni, S. R. (2004). Extreme programming in global software development. Canadian Conference on Electrical and Computer Engineering, pp. 1845-1848.

Yap, M. (2005). *Follow the sun: Distributed* Extreme Programming development. Proceedings of the Agile Development Conference, pp. 218-224.

Appendix A

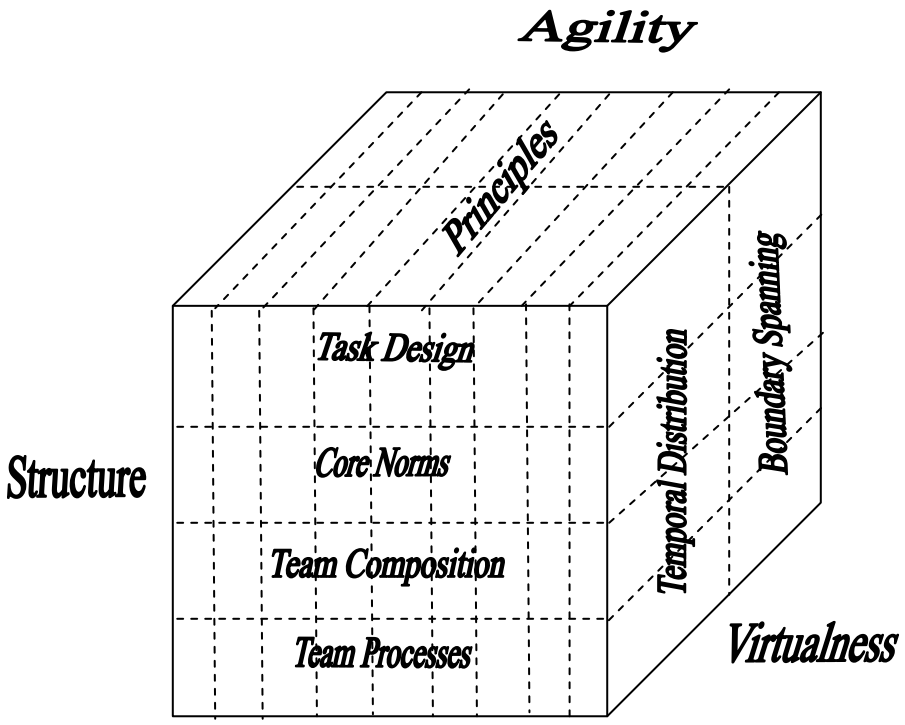

Fig 1. Global Agile Team Configuration Framework

Appendix B

Principles
1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Business people and developers must work together daily throughout the project.
3. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
4. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
5. The best architectures, requirements, and designs emerge from self-organizing teams.
6. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.
7. Deliver working software frequently, from a couple of weeks to a couple of months, with a prefe-rence to the shorter timescale.
8. Simplicity—the art of maximizing the amount of work not done—is essential
9. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
10. Working software is the primary measure of progress.
11. Continuous attention to technical excellence and good design enhances agility
12. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

Table 1. Summary of the Principles Behind the Agile Manifesto

Appendix C

Agile Principle	Virtual Challenge		Structure Configuration Characteristic
	Boundary Spanning	**Temporal Distribution**	
1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software	X	X	• Team Processes • Core Norms • Team Composition • Task Design
2. Business people and developers must work together daily throughout the project		X	• Team Processes • Core Norms • Team Composition
3. The most efficient and effective method of conveying information to and within a devel-opment team is face-to-face conversation	X	X	• Team Processes • Core Norms • Team Composition
4. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done		X	• Task Design
5. The best architectures, requirements, and designs emerge from self-organizing teams	X	X	• Team Processes • Core Norms
6. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly		X	• Team Processes • Core Norms
7. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale	X		• Team Processes • Task Design
8. Simplicity – the art of maximizing the amount of work not done – is essential	X	X	• Team Processes • Core Norms • Task Design
9. Welcome changing requirements, even late in the development. Agile processes harness change for the customer's competitive advantage	-	-	-
10. Working software is the primary measure of progress	-	-	-
11. Continuous attention to technical excellence and good design enhances agility	-	-	-
12. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace	-	-	-

Table 2. Agile Principles and Dimensions Unique to Global Agile Teams