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BEST PRACTICES FOR CONFIGURING GLOBALLY DISTRIBUTED AGILE TEAMS

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ABSTRACT

Drawing upon the extant literature this paper proposes a conceptual framework based upon the dimensions of agility, team structure, and virtualness to explore the question of how agile software development teams can be successfully configured in globally distributed environments. Based upon interviews conducted among five globally distributed agile teams a set of best practices is presented based upon these three dimensions.

Keywords: globally distributed agile teams, team configuration, agile development, global software development

INTRODUCTION

Although research exploring agile and distributed is increasing [2, 9, 14, 15], one area of study that has received limited attention is the actual configuration of teams employing agile methods in globally distributed environments. In general, team configuration in global settings is a complex phenomenon. While it is true that globally distributed teams encounter many of the same challenges as colocated teams, these are often exacerbated by physical distance as well as cultural and communication issues [10]. The use of agile software development methods, which describe ways of producing software in a lighter, quicker, more people-centered way, are currently touted as a way to alleviate the traditional challenges associated with software development [1]. However, a fundamental principle of agile methods is the efficacy of colocated teams in order to enable daily, face-to-face (FTF) interaction between stakeholders [7]. Couple this with the overall challenges of global software development and the issue becomes even more complex. With the increasing movement toward global virtual software development teams, however, the design of globally distributed agile teams becomes an important consideration. Therefore, our study explores the following research question: *How can agile software development teams be successfully configured in globally distributed environments?*

CONCEPTUAL FRAMEWORK

A configuration is an arrangement of constituent parts or dimensions. Based upon our research question and drawing on prior literature, we investigate the relationship between the dimensions of agility, team structure, and virtualness as shown in Figure 1 and discuss each briefly below.

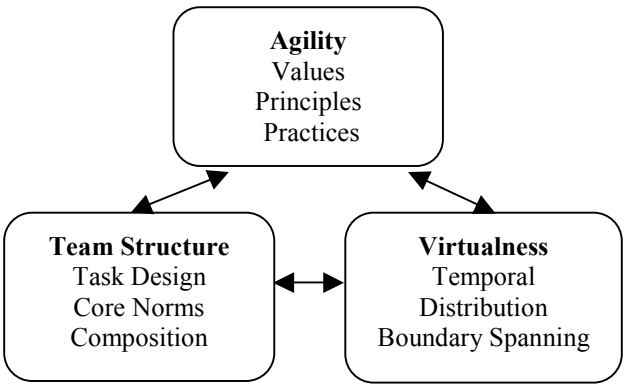

Figure 1: Dimensions of Globally Distributed Agile Team Configuration

Agility

Our research question deals specifically with teams using agile development methods. 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. 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 guiding principles [7]. 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. Agile methods represent a group of methods built upon the concepts of flexibility and adaptability rather than a single approach to development [1]. Extreme Programming (XP), Scrum, Feature-Driven Development and Adaptive Software Development are examples of current agile methodologies. To implement agile principles, these methodologies use various agile practices such as short iterations and small releases.

Team Structure

In work group design research, structural elements play an important role in the effectiveness of teams. Past research has identified task design, core norms of conduct and team composition as key structural elements to team success [8]. Task design addresses the issues of meaning, autonomy, and feedback. Core norms call for the establishment of appropriate behaviors expected of members. Team composition can include the elements of size, mix, and knowledge and skills.

Virtualness

Teams can be considered as more or less virtual based on the characteristics such as temporal distribution and boundary spanning. Temporal distribution denotes that a virtual team is distributed across time. Boundary spanning refers to the fact that virtual teams not only cross the boundaries of space and time, but also functional, organizational, and cultural boundaries as well [4].

RESEARCH METHOD

The objective of this study was to generate a set of best practices for configuring globally distributed agile teams. Due to the complex nature of this topic, the need to examine the phenomenon within its natural setting, and the limited amount of research that has been conducted in this particular area, this study utilized a qualitative embedded multiple-case research design based upon theoretical sampling through purposeful techniques for determining the cases to be explored. A case study represents "an empirical inquiry that investigates a contemporary phenomenon within its real-life context especially when the boundaries between phenomenon and context are not clearly evident" [17, pp. 13]. Put succinctly, case research is "useful when a phenomenon is broad and complex, where the existing body of knowledge is insufficient to permit the posing of causal questions, and when a phenomenon cannot be studied outside the context in which it naturally occurs" [5, pp. 207]. An initial research questions was posed to guide the direction of the study and a priori constructs were developed based upon the extant literature [6]. However, no a priori hypotheses, propositions, or relationships were formulated. Due to the number of cases the study was able to employ both literal replication logic and theoretical replication logic to explore the similarities and differences between the cases. Analysis of the data served to identify patterns or emerging themes based upon the three dimensions highlighted in the conceptual background.

Identification and Selection of Organizations

The identification and selection of organizations was based upon purposeful sampling using convenience and snowball sampling techniques [13]. Criteria for organization selection included the following: (1) globally distributed sites, (2) teams using an agile methodology in some form, and (3) a willingness to participate.

Ultimately, three organizations in transportation-related industries were selected. Two of the organizations were U.S. based, multi-national with employees located across the world. One organization was U.S. based and utilized offshore contractors as part of its team structure. The decision to include multiple organizations was made in order to increase the likelihood of multiple team configurations that would allow for sufficient examination of the dimensions of the theoretical framework and to increase internal validity of the study as the organizations were similar in that they were in related industries, they were globally in nature, and they were utilizing globally distributed agile teams. However, there were differences in overall size, organizational structure, and extent to which the organization supported the use of agile methods.

Organization A is a global IT services company based in the United States providing IT solutions to customers around the world. It employs a diverse group of approximately 135,000 employees world-wide. In addition to company employees it utilizes contract employees from various locations around the world. As a whole the organization still follows a structured, waterfall approach to software development as a part of its standard procedure. However, small pockets of individuals and teams are beginning to slowly implement the values, principles, and practices associated with agile methodologies. Currently this is being done primarily by a "champion" or "advocate", someone who is trained in agile methods and is leading the effort.

Organization B is a United States based company that employs approximately 40,000 employees and outsources the majority of its internal customer application development to a contracting company while keeping project management tasks onshore. In the past its primary focus has been on North America, but with the growing interest in the global economy it is beginning to take advantage of opportunities abroad as well. Organization B has also traditionally held to a structured, waterfall approach to its development. However, recently several informational sessions discussing the values, principles, and practices of the agile methodology have been offered to its employees and interest in their use has grown.

Organization C is a global technology solutions provider based in the United States with approximately 9,000 employees distributed in 45 countries. Organization C has adopted agile methodology from the top down. These methods are supported by the organizational leadership and their use is highly encouraged. Employees are required to attend mandatory training.

Identification and Selection of Cases

The unit of analysis should be directly tied to the research question and the selection of cases [17]. For this study the unit of analysis was the team itself which was embedded within the organization. Thus, after receiving organizational approval to proceed and the required non-disclosure agreements were signed the identification and selection of the cases was conducted. Cases were selected based upon theoretical sampling, not sampling logic, utilizing purposeful and snowball sampling techniques [6, 17]. Purposeful sampling "focuses on selecting information-rich cases whose study will illuminate the questions under study" [13, pp. 230] and the "specific type and number of cases selected depends on the study purpose and resources" [13, pp. 243]. Information-rich cases were defined as "those from which one can learn a great deal about issues of central importance to the purpose of the research" [13, pp. 46]. "There are no rules for sample size in qualitative inquiry" it is dependent upon multiple factors such as "what you want to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can be done with available time and resources" [13, pp. 244]. The specific criteria utilized were as follows: 1) the team was currently utilizing an agile methodology either formally or informally and 2) the team consisted of members who were distributed across global sites. For this study a total of five teams were included from the three participating organizations providing the appropriate number of cases for facilitating both literal and theoretical replication [6, 17]. Across all teams this study included 37 individual team members serving in multiple roles including software developers, project managers, architects, technical leads, business analysts, quality assurance analysts, and test analysts located in various parts of the world including Australia, Brazil, India, Mexico, Poland, and the United States.

Data Collection

The primary data collection method for this study consisted of individual, semi-structured telephone interviews. The interviews were initially scheduled for one hour, but actual interview times varied from approximately 25 minutes to one hour forty-five minutes. The total interview time for all interviews was approximately 30 hours while the transcription time was approximately 63 hours. The transcriptions of the interviews contained approximately 500 pages, 27,000 words, having a mean length of 4,000 words per interview. The process of data collection started with an initial conversation with the project manager of each team. The project manager assisted in determining which

individual team members to contact. In some cases, especially in smaller teams contacting all the members was suggested. In regard to the larger teams, the project manager attempted to provide a good mixture of roles and members with a stronger fluency in English for those located in other countries. This process followed the concept of purposeful sampling in order to identify key informants and information-richness [6]. Of course every member on the team was a potential key informant but due to time constraints and the busyness of each team member's schedule it was not possible to interview every member on every team. Additionally, some members did not respond after several email attempts. In the situation of two cases the offshore contractors were not available for interviews due to non-disclosure reasons. After receiving the list of members and their contact information, an email was sent to each member explaining the research study and asking for their participation.

The interviews were guided by an interview protocol and a case study protocol which were developed prior to conducting the interviews. The case study protocol served as a primary way of strengthening the case study reliability and is considered vital in a multiple-case study for ensuring that each interview is conducted in the same wary [17]. All participants were asked a series of demographic questions. Next, the participants were taken through a series of questions from the interview protocol which was developed from the theoretical framework. There were two sets of questions contained within the interview protocol, one set for the project managers and another set for the team members. If time allowed the project manager was asked both sets of questions. The questions focused on the specific dimensions of team structure, virtualness, and agility. In addition to the interviews, documents in the form of team hierarchy charts were collected to indicate the job title, primary role and location of each member.

Data Analysis

Case study research should adhere to both a general analytic strategy, to define priorities for what to analyze and why, and a specific analytic technique for detailed analysis of the data [17]. For the general analytic strategy this study adopted developing a case description which entailed the development of a "descriptive framework for organizing the case study" [17, pp. 114]. Specifically, the conceptual background was utilized to frame the interview data in terms of team structure, virtualness, and agility. In terms of the specific analytic technique this study employed within-case and cross-case analysis [6, 11, 17]. With reference to within-case analysis, the "overall idea is to become intimately familiar with each case as a stand-alone entity" [6, pp. 540]. For this study the cases were analyzed first by sorting text segments by their respective codes to uncover patterns of responses for each code in the coding list. The data were then further analyzed to explore similarities and differences in the cases. All within-case analysis was completed before the cross-case analysis was conducted [11, 17]. The purpose of cross-case analysis is to go deeper, the "aim is to see processes and outcomes across many cases, to understand how they are qualified by local conditions, and thus to develop more sophisticated descriptions and more powerful explanations" [11, pp. 172]. The basic idea was to conduct an in-depth study of one case and then to proceed to successive cases to see whether patterns or themes found match those in previous cases until a set of best practices for configuring globally distributed agile team configuration emerged [11].

BEST PRACTICES

Best Practice 1: Increase task meaningfulness via agile practices like short iterations and small releases

Structuring tasks so that they are meaningful was considered an important element for successful globally distributed agile teams. This notion is supported by prior literature on work group and team design [8] and distributed agile teams [16]. Specifically related to agility, we found that certain agile practices such as short iterations, small releases, iteration planning, iteration demos, and iteration retrospectives contributed to task meaningfulness by alleviating the overwhelming feelings that may accompany large, complex projects. By breaking the project into shorter iterations and small releases the team is able to see each of the smaller pieces as they come along as well as gaining a sense of the overall project purpose and goal, i.e., the "big picture". This is especially true in distributed teams where members are physically dispersed. One team member stated:

> *They [team members] need two things, they need one to understand how their tasks fit into the big picture, so they know how their actions affect others, and then they need to be given the freedom to do the work assigned to them, without being micromanaged. But, the flip side of that is that they do have to understand the critical path of the project and how their work affects others.*

In addition, regular meetings such as the daily stand-up, iteration planning sessions, iteration demos, and

iteration retrospectives provide the members with a constant stream of interaction with their colleagues and provide an understanding of how the project is progressing. It was suggested that these practices influenced meaningfulness which in turn impacted motivation, personal interests and quality.

Best Practice 2: Provide a high to moderate degree of autonomy

Globally distributed agile teams call for a moderate to high level of autonomy tempered by individual experience level and the nature of the project. In relation to autonomy and agility several shared concepts were identified including flexibility, creativity, ownership, accountability, shared responsibility, collaboration, and encouragement. If members in a globally distributed environment are not granted a high to moderate degree of autonomy, the agility of the team can be diminished because the members are waiting for direction from the project management team. For example, one interviewee stated:

> *The technical leadership and the project management or program management goes a long way to setting that feeling of autonomy [that] I can make decisions and [that I have] the empowerment. Give me the general guidance and direction and I will get you there…*

As the study suggested in situations where decisions do not alter the scope or priorities of the project members should have a high degree of flexibility.

Best Practice 3: Emphasize regular feedback via agile practices such as daily stand-up meetings, iteration planning, iteration demos, and iteration retrospectives, short iterations, small releases, continuous integration, and frequent builds

Regular feedback is a crucial aspect of a successful globally distributed agile team. Distributed teams do not have the same opportunities for casual interaction and feedback that a colocated team might have. In general, feedback from multiple sources was considered important regardless of whether it was positive or negative. For example, one interviewee stated:

> *Whether it is positive or negative feedback, especially well positive definitely, but then especially negative because if somebody is not doing it . . . you know, his or her work correctly, it . . . the person knows it ahead of time instead of, you know, after the project is done . . . then it is not time for the feedback. They have a chance to improve upon.*

The study indicated that agile practices actually contributed to the feedback loop via daily-stand-up meetings, iteration planning sessions, iteration demos, and iteration retrospectives. Because of the emphasis on regular and effective communication in agile methodologies regular feedback can greatly enhance the agility of the team and a lack of feedback may diminish agility. As was indicated by one of the participants, globally distributed agile teams are not communicating every few weeks, but more likely every day.

Best Practice 4: Establish expectations and roles upfront, but allow core norms to develop naturally among the team itself

Interviewees recommended that base core norms should be established up front. For example, one stated:

> *At the beginning of the project, the project manager or the program manager should establish those rules, and it may be only a short effort to do that. But yes, they should be established, but I think nowadays everyone acts professionally any way and adheres to all those and you know, a lot of those are unwritten rules and unspoken rules but everybody adheres to them.*

In relation to agility it was recommended that norms be established for certain agile practices such as the daily stand-up meeting to ensure it was conducted in an efficient manner and did not go on and on. On the other hand the sentiment for iteration planning, iteration demos, and iteration retrospectives was that time should not be so much of a factor and that each member should have ample opportunity to provide their input and ideas.

Best Practice 5: Keep teams as small as possible or break existing large teams into smaller sub-teams

Prior research has suggested that globally distributed agile teams be kept small [16]. As one member commented, "I think a smaller team is easier to handle and control and make sure everybody, you know, understands what everyone is doing. Easier to keep the small team moving in the same direction". Another member recommended that the team be no more than twenty members. This may be a good rule of thumb, but of course each situation is unique and the project

management team should carefully consider the number of members to be placed on the team. However, as the team grows it becomes more cumbersome and there is the law of diminishing returns. According to the study, smaller teams promote more effective communication, coordination, and control in a distributed environment which is very important in agile teams.

In relation to team size and agility the study revealed that the size of the team had an impact on the use of certain agile practices, namely those related to communication and collaboration. As the teams grew larger such practices as the daily stand-up meeting and iteration planning, for example, became less effective due to difficulty in managing the number of members, the time needed to allow all members to provide a status report, and a general loss of focus by the members. As the team grew it was suggested that it be broken into smaller sub-teams each having its own daily stand-up meeting, iteration planning sessions, etc.

Best Practice 6: Select sites with at least some degree of overlapping work hours, not simply the low cost location

Temporal distribution was considered a major factor for a successful team configuration and has a significant influence on the agility of the team. Other research has also cited temporal differences as a major concern [12, 14]. Because agile methods promote interaction on a day-to-day basis through the daily stand-up meetings and regular communication through such practices as iteration planning, iteration demos, and iteration retrospectives, having at least some degree of overlapping work hours between distributed locations was considered crucial. One interviewee stated:

> *. . . if you want quick answers…you are just waiting till like the next day and the person will get your email or you can't just call and talk to someone or, you know, or send an IM to them.. . . That's a big challenge. If there is a few hours difference, there should be some overlapping hours between the team members.*

On a consistent basis, teams indicated that geographic and even cultural differences were not nearly as important as time differences. Although benefits were cited, overall the consensus was that limited or no overlapping hours had a negative affect on the configuration of the team due to the fact that globally distributed agile teams need to have synchronous communication on a very regular basis. In this particular study the temporal distribution of the teams varied fairly significantly. Some teams had potentially 4 to 6 hours of overlapping work hours whereas other teams had no overlap. It was revealed by some members that the fact that at least they were in the same time zone or similar time zone with other locations enabled them to better implement an agile method. This suggests that organizations should not choose distributed locations simply based upon the lowest cost provider, but should take into consideration the time zone differences as well.

Best Practice 7: Utilize multiple ICT with an emphasis on desktop sharing, groupware or other collaborative technologies, teleconferencing, and instant messaging

The use of multiple forms of information and communication technology (ICT) was a great benefit to the team configuration. Desktop sharing, groupware or collaborative technologies, teleconferencing, instant messaging, were considered essential to the effective use of agile practices such as the daily stand-up meeting, iteration planning, iteration demos, and iteration retrospectives.. Usage, however, was not without issues. For example, one team member stated:

> *Of course, there are some challenges when I use the same application sharing with the person in India, well the lines are not as high band-width as it is here and I mean, the desktop, panes very slowly, it kind of also . . . you really need to exercise your patience and slow down the speed at which the network band-width allows, but, overall I still think that's a better option than trying to imagine or visualized what the other person is saying.*

While, synchronous ICTs were viewed as important, they are hindered by the lack of overlapping work hours due to time zone differences. As one member indicated, these technologies become useless if there is not someone in their office on the other end to receive them. Thus, pointing to the fact that even the sophisticated technologies cannot remedy the challenge of significant temporal distribution. The sites should have some degree of time zone synchronization, if possible.

Best Practice 8: Acknowledge that crossing multiple boundaries does not have to negatively impact the team, but upfront preparation is vital

Boundary spanning indicates that the team not only spans time and space boundaries but also (1) functional, (2) organizational, and (3) cultural boundaries.

The "ideal" virtual team would span these three multiple boundaries [4]. In this study, teams did indeed span these boundaries to varying degrees. Some spanned all three boundaries while others spanned only one or two. Regardless, the findings indicated that spanning functional, organizational, and/or cultural boundaries did not negatively impact a successful globally distributed agile team configuration. This was somewhat surprising from a cultural spanning perspective because other research has cited this as a concern [3, 12]. One interviewee stated:

> *We do work with people in Europe, Australia, America, and of course Asia. Different clients and different people in different organizations. But it doesn't affect our project, I think ultimately we all work toward a common goal and make it work.*

One member mentioned that currently "there are tools that the company has for calibration to different cultures because different cultures do different things." Thus, an environment of cultural sensitivity has been developed in these organizations due to the global nature of the work. A member on another team stated "I think we are very, very sensitive and reactive to those, to those cultural and time zone, temporally spaced differences." We emphasize that the organization must be proactive in addressing boundary spanning issues at the beginning of each project. One interviewee suggested that addressing boundary spanning issues in the project kick-off meeting can be very helpful. He stated:

> *I think it is laid out well during kick-off time and we very seldom have to go back and review it, but if you did have the need it is there for us. So, I think it does help. And especially during, you know, the forming/storming/norming phases because at first they are . . . that is where I have noticed that there is some virtual differences or some cultural differences in the virtual world and you really have to emphasize that you want to hear from everybody in the group, for example. And so, at least stating that upfront so people understand that does help.*

CONCLUSION

Overall, our study supports previous literature indicating that agile methods can be implemented in globally distributed environments; recognizing, however, that there are important considerations to take into account in regard to the team configuration. We specifically investigated the best practices for configuring teams that use agile methods in terms of agility, team structure, and virtualness. The utilization of globally distributed agile teams has the potential to significantly impact the field of software development. As such, our hope is that the identification of these three key configurational elements and the recommendation of these best practices can serve to benefit practitioners as they seek to configure globally distributed agile teams in their own organizations. Table 1 summarizes our findings for best practices.

Table 1: Best Practices for Configuring Globally Distributed Agile Teams

1. Increase task meaningfulness via agile practices like short iterations and small releases
2. Provide a high to moderate degree of autonomy
3. Emphasize regular feedback via agile practices such as daily stand-up meetings, iteration planning, iteration demos, and iteration retrospectives, short iterations, small releases, continuous integration, and frequent builds
4. Establish expectations and roles upfront, but allow core norms to develop naturally among the team itself
5. Keep teams as small as possible or break existing large teams into smaller sub-teams
6. Select sites with at least some degree of overlapping work hours not simply the low cost location
7. Utilize multiple ICT with an emphasis on teleconferencing, instant messaging, and desktop sharing
8. Acknowledge that crossing multiple boundaries does not have to negatively impact the team, but upfront preparation is vital

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