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Citation for published version (APA):
Persson, J. S., Aaen, I., & Mathiassen, L. (2008). Real-time Control Mediation in Agile Distributed Software Development. In *Proceedings of the Fourteenth Americas Conference on Information Systems, Toronto, ON, Canada August 14th-17th 2008: AMCIS 2008 Proceedings* Association for Informations Systems, AIS. http://aisel.aisnet.org/amcis2008/293/

Real-time Control Mediation in Agile Distributed Software Development

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ABSTRACT

Agile distributed environments pose particular challenges related to control of quality and collaboration in software development. Moreover, while face-to-face interaction is fundamental in agile development, distributed environments must rely extensively on mediated interactions. On this backdrop, we report from an in-depth case study of an agile distributed software project. Applying Kirsch's elements of control framework, we analyze how actors in this context used different elements of control. We offer a description of the general management context and provide a detailed analysis of how control was mediated over distance by technology through real-time exchanges. Contrary to previous research, the analysis suggests that both formal and informal elements of real-time mediated control were used; that evolving goals and adjustment of expectations were two of the main issues in real-time mediated control exchanges; and, that the actors, despite distances in space and culture, developed a clan-like pattern mediated by technology to help control quality and collaboration in software development.

Keywords

Distributed development, global software development, control theory.

INTRODUCTION

Two significant trends have emerged in software development practice over the past years: Agile methodologies and geographical distribution. These are recently being combined, so agile development methods are used in geographically distributed contexts (Agerfalk and Fitzgerald, 2006; Armour, 2007; Holmström, Fitzgerald, Ågerfalk and Conchúir, 2006; Ramesh, Cao, Mohan and Xu, 2006). Combining distributed development with agile principles does, however, represent particular control challenges related to balancing fixed vs. evolving quality requirements and people vs. process based collaboration (Ramesh et al., 2006). While agile principles with lightweight processes and primary reliance on skilled people offer advantages in terms of flexibility, speed, and learning, there is a risk that agile practices in distributed environments may further reinforces the well known difficulties related to control of quality and collaboration.

Studies of control in geographically distributed contexts have been conducted in relation to issues such as trust (Piccoli and Ives, 2003), culture (Narayanaswamy and Henry, 2005), and effectiveness (Piccoli and Ives, 2000). Kirsch (2004), however, calls for research to more closely examine the role of the global context on control choices and impacts. The global context is described in terms of priority differences among locales, time zone, cultural variations, and geographical differences. Further calls for research on control in geographically distributed contexts has also been made by Powell et al. (2004). In their literature review, they question whether informal control mechanisms in general can be used when teams are short-lived and rarely meet face-to-face. Needless to say, this concern increases as agile principles are adopted, simply because these principles mainly rely on face-to-face communication.

On this backdrop, we investigate how different elements of control are adopted in agile distributed development; in particular how different elements of control are mediated over distance by various forms of technology through real-time exchanges. The following in-depth single case study investigates the controls introduced in real-time communication to manage the challenges in an agile distributed development environment. We seek to contribute to the limited research in this area

(Agerfalk and Fitzgerald, 2006; Lee, Banerjee, Lim, Kumar, Van Hillegersberg and Wei, 2006) by addressing the following research question:

How are real-time mediated controls adopted to help manage agile geographically distributed software projects?

CONTROL OF SOFTWARE PROJECTS

In the research of management of software development, Kirsch (1996; 1997; 2000; 2004) has advocated the control perspective proposed by among others Ouchi (1978; 1979; 1980) and Eisenhardt (1985). Control is viewed broadly to mean any attempt to motivate individuals to behave in a manner consistent with organizational objectives (Kirsch, 2004; Ouchi, 1979). Control is divided as either formal or informal. Formal control is viewed by organizational researchers as a performance evaluation strategy, where either behaviors or outcomes are measured, evaluated, and rewarded (Eisenhardt, 1985; Kirsch, 1996). Informal control differs from formal control in that it is based on social and people strategies (Eisenhardt, 1985; Kirsch, 1996). Different modes or mechanisms of control are, however, not applied individually (Ouchi, 1979). They each contribute to a portfolio of control mechanisms representing a specific management practice in different organizational contexts (Kirsch, 1997).

In her recent work, Kirsch (2004) focuses on formal and informal control in relation to four elements of control. These four elements are measurement, evaluation, rewards and sanctions, and roles and relationships as shown in **Table 1**. The first three elements are based on a literature review by Eisenhardt (1985). The last element, roles and relationships, is an addition by Kirsch (2004).

Element	Formal	Informal
Measurement	• pre-specified and formally documented goals and/or behavior are available • control modes align the goals of controller and controllee • goals and/or behaviors are measurable	• few specified behaviors or procedures available • implicit specification and measurement of group values and norms • goals evolve over time • desired end-states result when individual behavior is consistent with the shared norms and values
Evaluation	• information about rules, procedures, behaviors, and goals are exchanged • information is exchanged in formal, written documents such as standard operating procedures or status reports • evaluation assesses whether behavior is resulting in forward progress	• information about norms, values and expectations exchanged • socialization, training, discussions, dialogs, and meetings serve as mechanisms of information exchange • goal of evaluation is to build and foster collegial relationships characterized by common values and norms
Rewards and sanctions	• based on following specified rules or achieving specified targets • formal organizational mechanisms include pay, bonuses, promotion or demotion	• based on acting in a manner that is consistent with group norms and values • mechanisms include group recognition and peer pressure
Roles and relationships	• focus is usually on dyads • controller and controllee are often in a formal superior-subordinate relationship or in a relationship that is consistent with the organizational hierarchy	• often a work group or professional society • may be a clan, which is a group of individuals who are dependent on each other to accomplish their work and who are committed to achieving group goals

Table 1. The elements of control (Kirsch, 2004).

Measurement is an element of control which formally implies that behaviors or outcomes are explicitly specified and measurable. Informal measurement is when norms, values, or behavior are implicitly specified and measured. **Evaluation** refers to performance and information exchange. Formal evaluation is based on specified information regarding behavior and outcome, where it is assessed if current status leads to forward progress. Informal evaluation is referring to norms and values that characterize a functional relationship, which is assumed to lead to performance. The functional relationship is achieved by socialization through dialog or discussions. **Rewards and sanctions** are in a formal setting based on achieving specific goals or adhering to pre-specified behavior. Formal rewards could be bonuses and formal sanctions could be demotions. Informal rewards and sanctions are based on whether a behavior is consistent with group values and norms. Informal rewards could be peer recognition while informal sanctions could be social exclusion. **Roles and relationships** are added by Kirsch (2004) as an elaboration of the three previously mentioned elements of control. Formal roles and relationships imply particular roles and usually a focus on dyadic relationships. Informal roles and relationships appear in groups of individuals dependent on each other and committed to group goals (Kirsch, 2004).

RESEARCH APPROACH

The research question was investigated through a case study following the guidelines proposed by Yin (2003). The case is a joint venture project between a small Danish software company and a Russian R&D outsourcing provider. The project was conceived by the Danish company Area9 established in 2006 by two doctors and two computer scientists, all of whom previously had management positions in another software company also relying heavily on offshore developers. Area9 have had offshore developers in Russia and India from the very beginning.

There were two full time and five part time developers in Russia at the beginning of the case study. Area9 have based their development practices on agile principles, and claim distributed projects should be managed as if the developers where located in Denmark. This management practice requires that the developers are able to work in an agile environment and have excellent communication and collaboration skills. Their agile practices include among others continuous integration, parallel development and testing, incremental design, code reviews, and sparse documentation. In the day to day coordination between sites, they use frequent reviews and meetings structured via mind maps.

The case study data was collected over a half year period. The primary data for this research was observations of the e-conferences between the project participants. The secondary data was a series of interviews with the project participants, investigating the contextual setting for the e-conferences. The communication media used in the e-conferences were Skype and a working prototype of the collaborative mind-mapping tool Co-mapping under development, see www.comapping.com. It should be noted that even though the mind-mapping tool had not been released for open beta when the case study was initiated, it had all its basic functionality. From early in the project beta-versions of this tool were used for project coordination and played a vital role in the management of its own development. During the conferences the main author was present offsite as a passive observer while audio recording the conversations and video recording the activities in Co-mapping. A total of 10 observations were done from late February to early July 2007. However, in an effort to further our understanding of the context for the real-time control mediation being observed, eleven semi structured interviews were conducted. The interviews were initiated with a face-to-face meeting with a key project participant. After this first meeting, a series of interviews with all fulltime project participants were conducted on Skype. The interview objective in relation to this paper was to investigate the reasoning of current control choices in relation to measurement, evaluation, rewards and sanctions, and roles and relations. Towards the end of the case study, a new series of interviews were conducted with the project participants and the CEO of Area9. The objective of these interviews was to uncover the dynamics of control choices during the project, providing retrospective reasoning of control choices. During these interviews the Co-mapping tool was used in collaboration between the interviewer and interviewee to model a timeline of the project.

The data analysis was conducted with the qualitative data analysis software Atlas.ti V5.2 (GmbH, 2007). All fourteen hours of recordings were loaded into the software and carefully listened through. Exchanges pertaining to control (see **Table 1**) were identified and coded as one of the three original elements of control (measurement, evaluation, rewards and sanctions) as well as with one of the roles or relationship types. Furthermore, one or more descriptive codes related to the specifics of the element of control were added to each exchange. A total of 24 exchanges in the e-conference observations were identified and tagged as summarized in **Table 2** (underlined numbers in the table indicate where more than one descriptive code was applied).

RESULTS

The Co-mapping project started at Area9 February 2006 with an idea of a web-based mind map system. The idea was presented for their Russian outsourcing provider and in April 2006 the joint venture project between the two companies was

established. The two companies had equal ownership but made different contributions to the project. The Russian partner assigned two developers to the project while Area9 provided the management, architectural, and design expertise. With both of the IT professionals in Area9 working as full time developers on the project along with the two Russian developers, there was a proof of concept ready the following month. However as the project evolved, the Area9 participants decreased their contribution as developers leaving more responsibility to the Russian developers. The change meant one of the Area9 participants stopped as developer while the other who previously had the primary responsibility for product development handed over that role to one of the Russian developers. The remaining Area9 participants did limited development and continued in a role as technical consultants. Another change in April was the hiring of three part time managers for the project. The three managers were supposed to develop a commercial strategy for the product. However, the three managers were not able to agree on a strategy and spent their time debating options and challenges. In December 2006, the three managers were released from the project. The Area9 CEO resumed management responsibilities along with the technical consultant and the Russian project manager. It was at this time with the change to a technically oriented management our case study was initiated. However, the technical oriented management period was short-lived. There was an agreement in the project that they still needed a business strategy for the product. In late April 2007 one of the three managers rejoined the project as full time CEO. A few months later a golden opportunity appeared as an S&P 500 company partner was found. The external partner customization became the primary project objective and staff was increased to eight full time developers. Our case study ended in July 2007 when the golden opportunity reorientation started.

Control was exercised in the project by multiple actors and in various forms. The control settings included face-to-face meetings, instant messaging, emails, and e-conferences. The e-conferences were conducted with Skype and the Co-mapping tool being developed. Co-mapping supports collaborative mind mapping[1]. The Co-mapping tool was central in the management of the Co-mapping development project. One to three times a month an e-conference was held between the technical consultant and the project manager. When the new CEO started he also participated in the e-conferences. The conference language for e-conferences was English and all e-conferences took place within normal working hours due to a time-zone difference of only two hours between the sites. **Table 2** summarizes the distribution of control observations from the Co-mapping project mediated by technology during e-conference.

Elements of Control	Formal	Informal
Measurement (9)	Documented Specified goals Specified behavior Goal alignment	Norms and values (1) Evolving goals (8)
Evaluation (12)	Rules Procedures (3) Specified goals (3) Specified behavior Documented (3)	Norms and values Expectations (6) Socialization Training Dialogs (2)
Rewards and sanctions (3)	Rules Specified targets Pay Bonuses Promotion Demotion	Norms and values (1) Group recognition (2) Peer pressure (1)
Roles and relationships (24)	Dyad (4) Hierarchal	Work group (11) Professional society Clan (9)

Table 2. Distribution of control observations during Co-mapping project e-conferences.

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[1] A mind map is a diagram used to represent words, ideas, tasks, or other items linked to a central key word or idea. Co-mapping makes it possible to work on such mind maps in real time by visualizing the movements and inputs of one participant to other participants.

Measurement

Real-time mediated control in the Co-mapping project relied on informal measurement. In fact, all nine observations related to measurement were of an informal nature. The observations of the e-conferences revealed informal instances of measurement based on norms and values and evolving goals. One example of the reliance on shared norms and values was observed in a discussion of system performance optimization between the technical consultant and project manager. The CEO pointed out that he relies on their capabilities concerning technical issues:

> **CEO** *(Denmark): I don't understand it but I imagine I don't have to.*
>
> **Project manager** *(Russia)* **& technical consultant** *(Denmark) concurrently: You don't have to.*
>
> **Technical consultant** *(Denmark): This is a good thing to fix because this was a major performance problem.*
>
> **Project manager** *(Russia) interrupts: Yeah, it was very easy to fix after all and was a major performance problem, it slowed down the server a lot.*

The roles and relationships in this instance indicate a Clan-like pattern due to the mutual dependence required to achieve project goals. The specific goals of the project were, however, very dynamic and continuously negotiated. The goal changes often occurred by the end of e-conferences where the content of the current sprint and its deadline usually are discussed. A deadline was, however, not always set for a sprint. The participants might choose to wait until they had gained more knowledge of a given issue. In other instances they simply moved the deadlines. The CEO several times tried to introduce more specific and stable goals. At one instance he suggested a contingency plan of when to do server upgrade. This more detailed planning approach did, however, meet resistance from the technical consultant. He argued for a sense and response approach based on an estimated high probability for quick diagnostics and problem solving. Differences of opinions between these two also appeared in a discussion of what major features should be developed. The CEO stated he had told people a desktop version of the system would be available within two months. He, however, still wanted new features for their current web-based system. The technical consultant heatedly opposed this and argued that he had to prioritize, as shown in the transcript:

> **CEO** *(Denmark): I was asking if we can devote one resource so something is happening to the desktop version.*
>
> **Technical consultant** *(Denmark): But that doesn't make sense, you need to answer the question, what is it you want from a business point of view, so if you say I want all of it you didn't answer the question.*
>
> **Project manager** *(Russia): You have to say what you want first.*
>
> **Technical consultant** *(Denmark): Yes, so it doesn't make sense to say we just need to keep the kettle burning on the desktop version, and therefore we should assign someone. That is not a good way to approach it I think. It is better to say what are the priorities, what is it I want to have first. Do you want the server installer before you want the desktop version or do you want the desktop version before you want the server installer or what is it you want?*
>
> **CEO** *(Denmark) interrupts: Okay, then I'll suggest we will just wait with this for a while until we are more certain.*

In this exchange, the project manager and technical consultant relied on the clan structure in terms of the CEOs dependence on their estimations as they argued that a high level of uncertainty calls for prioritizing of a single main feature. The focus on a few prioritized features can also be seen as a key premise for managing evolving goals, as many concurrent goals would make this practice more difficult. This was also pointed out by the technical consultant at an interview in relation to the introduction of sprints early in the development project to structure their tasks in the mindmap. When they didn't use the sprint structure the project manager and his team experienced difficulties in prioritizing and consequential low productivity.

Evaluation

Evaluation was both formal and informal in the Co-mapping project, with an almost equal amount of observations for each type of control. The formal controls were in the form of procedures, specified goals, and documentation. The informal controls were in the form of expectations and dialogs. An example of a frequent formal procedure was the review:

> **Technical consultant** *(Denmark): So do I need to do anything on that one [Easy sign up feature].*
>
> **Project manager** *(Russia): Probably not.*
>
> **Technical consultant** *(Denmark): So when you have something I can review it.*
>
> **Project manager** *(Russia): Yeah.*
>
> **Technical consultant** *(Denmark) places the 50% symbol next to the task in the mind map: Ok great, so it is fair to say it is 50% done.*

Review agreements were continuously made throughout the e-conferences, as shown in the above quote. It was not only the project participants doing reviews for each other; sometimes they planned reviews to be conducted by other people in their respective companies. In some cases, the participants also conducted reviews of new features during the e-conferences by switching to consider the development version of the system. There was also a documentation aspect of the review procedure when they either wrote down who should do the review or as in the example above when they noted the task status in the mind map. The informal part of the evaluations was continuous negotiations of expectation:

> **CEO** (Denmark): *Are you okay with this, or is it too much?*
>
> **Project manager** (Russia): *Let me just do a quick review – This should be fine, I think. The number ones are definitely doable shall we say two weeks as usual?*
>
> **Technical consultant** (Denmark): *If you prefer so that would be fine.*
>
> **Project manager** (Russia): *Okay let's go for two weeks – if we do well we can move faster – but I'm sure some other things will be popping up.*

In this exchange, the tree participants made an effort to balance their expectations through dialog. First, it was done by the CEO when he checked the expectation buildup by the end of the e-conference in the start of the exchange. Second, it was done by the project manager as he reminds the others of the usual uncertainties that might cause delays.

Rewards and Sanctions

Reward and sanction controls were rarely observed during the e-conferences. There were no formal controls observed, only a few of an informal nature. Group recognition was one of these informal controls. One example was the technical consultant commenting the work by the project manager:

> **Technical consultant** (Denmark): *So you made the map work with Joomla.*
>
> **Project manager** (Russia): *Yes.*
>
> **Technical consultant** (Denmark): *It looks good.*
>
> **Project manager** (Russia) after two seconds of silence: *And I actually found out I had to patch Joomla a bit to accept emails as user names – that is already done.*
>
> **Technical consultant** (Denmark): *Great.*

However participants did not only apply informal rewards but also sanctions in the form of peer pressure. In the following exchange it concerns the amount of features in the first update of the system since its public release:

> **CEO** (Denmark): *So we just have [the features] publish maps and add notes?*
>
> **Project manager** (Russia): *Yes, and the new share dialog…*
>
> **CEO** (Denmark): *… It's been six weeks right - and we are going into the seventh week - so in two months we come out with two features.*
>
> **Project manger** (Russia): *Which is not good I agree - Which is not impressive.*
>
> **CEO** (Denmark): *No…*

In this exchange, the CEO indirectly pressured the project manager to do more features for the upcoming system update[2]. This particular peer pressure relied on an implicit norm of what is an acceptable level of productivity for the given period of time. Further, it was supported by the clan mentality focusing on "We" underlining the mutual dependence and shared productivity norms.

DISCUSSION

Previous research (Harris, Hevner and Collins, 2006) suggests that clan-like control as found in agile development is likely to be more difficult to practice in a distributed setting when interaction is not face-to-face but mediated by technology. Contrary to this claim, the results from the Co-mapping project suggest that agile practices and related elements of control were pervasively observable in real-time mediated exchanges between project participants. In the following, we substantiate this

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[2] The e-conference was held June 26th and the update was released July 11th including six new features.

finding by reviewing the results from the Co-mapping project in relation to our research question: How are real-time mediated controls adopted to help manage agile geographically distributed software projects?

First, we found instances of exchanges mediated by technology in real-time involving all of Kirsch's (2004) first three elements of control: measurement (9), evaluation (12), and rewards and sanctions (3). Moreover, there were considerable elements of both informal (21) and formal (9) control even though emphasis was uneven across the three elements. Related to measurement and rewards and sanctions, the emphasis in the Co-mapping project was entirely on informal control. In contrast, there was equal emphasis on formal and informal control related to evaluation. The tendency towards informal control can be due to meetings being mostly informal exchange mechanism (Kirsch, 2004) and all the e-conferences observed were in that sense meetings. On this backdrop, the use of formal evaluation controls during e-conferences is surprising. There are, however, differences between traditional meetings and meetings mediated by Skype and Co-mapping. Compared to face-to-face communication, these lean communication media may call for more structure in form of procedures and documents with the absence of nonverbal cues. The application of the Co-mapping tool in the project appeared to address the need for structure during meetings with an absence of nonverbal cues. The Co-mapping tool therefore could be useful in other agile distributed software projects experiencing structural difficulties in mediated meetings.

Second, evolving goals and adjustment of expectations were the most frequent control characteristic in the Co-mapping project. In fact, these two characteristics accounted for nearly half (14) of the coded characteristics (30) in the case study. The frequent evolving goals and exchanges concerning expectations can be due to project members' limited experience with the technology which may impact their ability to estimate the complexity of the various tasks making deadlines subject to continues change. Another reason may be the high level of uncertainty related to who the commercial target group was for the system. The preference towards evolving goals and addressing expectations can also be seen as a product of a sense and respond culture in the project and Area9 (Haeckel, 1999).

Third, a number of observations relate to how control was expressed through roles and relationships. We found no instances in which formal, hierarchical relationships were expressed. It should, however, be noted that even though not applied the participants did have hierarchical controls available (as indicated by their formal titles) in the contextual structure surrounding the e-conferences. The absent reliance on formal roles and relationships in the e-conferences can, however, be seen as a supporting element of the informal relationships, as the CEO also pointed out in an interview. Quite a number of informal work group relationships (11) was observed and can be seen as an expression of the nature of the underlying project organization. Furthermore there was quite a number of informal clan like patterns (9) as an expression of the high level of mutual dependence among team members. The clan pattern is not surprising considering it is an agile development project (Harris et al., 2006). It is, however, surprising when considering the argued difficulties for clan control in a distributed setting. Harris et al. (2006) argue this control type is likely to be more difficult in a distributed setting when interaction is not face-to-face but mediated by technology. Furthermore, clan control may also be more challenging when participants come from different organizations (e.g. when consultants are used or when development is partly outsourced). The appearance and effectiveness of clan controls in the Co-mapping project is likely due to a high level of trust and a long term relationship between not only the participants, but also the two companies, since increased trust leads to fewer formal controls and more informal controls (Kirsch, 2004). The informal roles and relationships may also be the reason for all participants acting as both controller and controllee.

CONCLUSION

To the best of the authors' knowledge this is the first empirical study of how various elements of control are used in agile distributed software development. Contrary to expectations, agile principles were in this case successfully adapted to a distributed setting and were highly visible in project participants' mediated real-time exchanges over distance. As a result, the project was managed with a high reliance on informal control with effective trust mechanisms across organizational, cultural, and geographical distance. These preliminary findings point in direction of further investigations to help us understand in more detail and across different development environments how various forms of control can be mediated in real-time over distance to support agile development efforts. The authors plan to do further research on how the Co-mapping tool affects the observed control patterns.

REFERENCES

1. Agerfalk, P.J., and Fitzgerald, B. (2006) Flexible and distributed software processes: Old petunias in new bowls?, *Communications of the ACM*, 49, 10, pp 26-34.

2. Armour, P.G. (2007) Agile ... and offshore - An interview with a new paradigm, *Communications of the ACM*, 50, 1, pp 13-16.

3. Eisenhardt, K.M. (1985) Control - Organizational and Economic Approaches, *Management Science*, 31, 2, pp 134-149.

4. GmbH, S.S.D. (2007) ATLAS.ti V.5.2 - The Knowledge Workbench - http://www.atlasti.com/.

5. Haeckel, S.H. (1999) Adaptive Enterprise: Creating and Leading Sense-and-Respond Organizations Harvard Business School Press, Boston.

6. Harris, M., Hevner, A.R., and Collins, R.W. (2006) Controls in Flexible Software Development, *Hawaii International Conference on System Sciences*, IEEE, Hawaii, pp. 216a- ?

7. Holmström, H., Fitzgerald, B., Ågerfalk, P.J., and Conchúir, E.Ó. (2006) Agile Practices Reduce Distance in Global Software Development, *Information Systems Management*, 23, 3, pp 7-18.

8. Kirsch, L.J. (1996) The management of complex tasks in organizations: Controlling the systems development process, *Organization Science*, 7, 1, pp 1-21.

9. Kirsch, L.J. (1997) Portfolios of control modes and IS project management, *Information Systems Research*, 8, 3, pp 215-239.

10. Kirsch, L.J. (2000) Software project management: An integrated perspective for an emerging paradigm, in: Framing the Domain of IT Management: Projecting the Future Through the Past*, R.W. Zmud (ed.), *PinnFlex Education Resources*, Cincinnati, OH, pp. 285–304.

11. Kirsch, L.J. (2004) Deploying common systems globally: The dynamics of control, *Information Systems Research*, 15, 4, pp 374-395.

12. Lee, O.K., Banerjee, P., Lim, K.H., Kumar, K., Van Hillegersberg, J., and Wei, K.K. (2006) Aligning it components to achieve agility in globally distributed system development, *Communications of the ACM*, 49, 10, pp 48-54.

13. Narayanaswamy, R., and Henry, R.M. (2005) Effects of culture on control mechanisms in offshore outsourced IT projects, *Proceedings of the 2005 ACM SIGMIS CPR conference on Computer personnel research*, Atlanta, Georgia, USA, pp. 139-145.

14. Ouchi, W.G. (1978) Transmission of Control through Organizational Hierarchy, *Academy of Management Journal*, 21, 2, pp 173-192.

15. Ouchi, W.G. (1979) Conceptual-Framework for the Design of Organizational Control Mechanisms, *Management Science*, 25, 9, pp 833-848.

16. Ouchi, W.G. (1980) Markets, Bureaucracies, and Clans, *Administrative Science Quarterly*, 25, 1, pp 129-141.

17. Piccoli, G., and Ives, B. (2000) Virtual teams: managerial behavior control's impact on team effectiveness, *Proceedings of the twenty first international conference on Information systems*, Association for Information Systems, Brisbane, Queensland, Australia, pp. 575-580.

18. Piccoli, G., and Ives, B. (2003) Trust and the unintended effects of behavior control in virtual teams, *MIS Quarterly*, 27, 3, pp 365-395.

19. Powell, A., Piccoli, G., and Ives, B. (2004) Virtual Teams: A Review of Current Literature and Directions for Future Research, *Database for Advances in Information Systems*, 35, 1, pp 6-36.

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

21. Yin, R.K. (2003) Case Study Research: Design and Methods, (Third ed.) Sage Publications Inc, Thousand Oaks, California, p. 200.