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Control, Process Facilitation, and Requirements Change in Offshore Requirements Analysis: The Provider Perspective

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Abstract:

Process, technology, and project factors have been increasingly driving organizations to offshore early software development phases, such as requirements analysis. This emerging trend necessitates greater control and process facilitation between client and vendor sites. The effectiveness of control and facilitation, however, has not been examined within the context of requirements analysis and change. In this study, we examine the role of control and facilitation in managing changing requirements and on the success of requirements gathering in the Indian offshore software development environment. Firms found that control by client site-coordinators had a positive impact on requirements analysis success, while vendor site-coordinators did not have similar influence. Process facilitation by client site-coordinators affected requirements phase success indirectly through control. The study concludes with recommendations for research and practice.

Keywords: Offshoring, outsourcing, global software development, GSD, requirements analysis, offshore outsourcing, control, process facilitation, requirements change.

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INTRODUCTION

Cost efficiencies, improved communications infrastructure (Gopal et al. 2002; Sahay et al. 2003), and access to specialized skills (McAulay et al. 2002) have supported a greater distribution of software development processes across offshore locations. More significantly, volatile software requirements, fueled by project size and complexity, rapidly evolving technologies, and changes in organizational context such as business goals, market trends, and regulatory pressures, are putting perceptible pressures on offshoring early software development phases, including requirements analysis. In light of such impermanency, even though requirements are gathered initially on-site, further discovery becomes necessary during design and development stages (Jarvenpaa and Mao 2008).

As organizations experience cost-cutting pressures, facilitating successful virtual requirements determination is increasingly perceived as a worthwhile undertaking. The advent of collaborative technologies such as videoconferencing is rapidly converting this need to reality. For instance, the pressures to transport requirements engineers to remote client locations are partially mitigated by use of computer-supported collaboration (Damian 2002; Boehm et al 2001; Edwards and Sridhar 2005; Yadav et al. 2009). Going forward, there is likely to be a greater need to comprehend the factors that influence the success of requirements determination in offshore settings. The focus of this study is to fill this timely need.

Coupled with the inherent nature of offshore software development, managing volatile requirements necessitates greater control and process facilitation for accomplishment of desired project goals (Yadav et al. 2009; Wang et al. 2008). Requirement gathering is a customer-centric engagement (Urquhart 2000), the success of which depends upon effective collaboration between clients and vendors and "mutual control of the process by all players" (Holtzblatt and Beyer 1995, p. 32). High-performing IS teams exhibit greater levels of control because team members "systematically affect the behaviors of each other" (Henderson and Lee 1992, p. 757). Such control and process facilitation are likely to enable organizations to deal with short development timeframes, resource constraints, and customer demands. With such variability, client-vendor goals may need frequent realignment to prevent operational breakdown in communications, misinterpretation of requirements, and challenges with quality standards. As such, control practices and facilitation skills of site-coordinators for harmonizing between on-site and offshore teams have become more central to successful project execution (Battin et al. 2001).

Control and process facilitation have been examined in IS literature for more than two decades, with primary emphasis on facilitation between onshore project managers and IS teams (e.g. Henderson and Lee 1992). Only recently has there been an emphasis between teams on outsourced projects (e.g. Tiwana and Keil, 2009; Rustagi et al, 2008). These studies have mostly examined control and facilitation over the entire systems development cycle. However, to our knowledge, none has focused on their effectiveness during requirements determination. Fundamentally, requirements pose unique challenges because they are difficult to define fully at the outset; at the same time, the success of offshored IS projects is crucially dependent on well-developed and clearly communicated user needs (Mao et al 2008). Requirements determination for offshored projects is mired with communication challenges and misinterpretation arising from distance, cultural effects, and language (Rai et al. 2009; Holtzblatt and Beyer 1995; Lacity and Rottman 2008). For instance, vendor teams must deal with conflicting goals of the client's IT group and its business community, even as client teams are still learning to be effective at transference between offshore and co-located teams (Bhat et al. 2006). Requirements transfer and analysis requires integration of both tacit and explicit knowledge across client and vendor firms (Nicholson and Sahay 2004). Inadequacy of structural and social factors challenge the exchange of such rich knowledge, potentially lessening the chances for project success (Rai et al. 2009). Strong social networks that typically facilitate face-to-face requirements determination are challenging to replicate in offshore mode (Lacity and Rottman 2008), further complicating the interchange between client-vendor teams. Considering these factors, examining control and process facilitation in requirements phases of offshore projects might reveal untapped insights into project success.

The goal of this study, then, is to extend existing research on control and process facilitation of offshore vendors to requirements determination phase. Our population of interest was Indian IT service providers. Although several Asian and European nations have evolved to serve as low-cost destinations for IT-related sourcing needs (Lahiri and Kedia 2009; Lacity et al. 2008), India has emerged as the primary provider for global IT services. According to recent estimates from the National Association of Software and Services Companies (NASSCOM), a nodal trade association of the Indian IT-BPO industry (www.nasscom.org), offshore software product development in India was

expected to exceed US $1.2 billion in 2012 exports. NASSCOM (2007), also reports that India ranks the highest in the world in global sourcing destinations. Its share in global IT sourcing has grown from 62% to 65% percent for IT outsourcing and 39% to 45% for business process outsourcing. Considering this expanding potential of Indian IT providers and maturity in their IS development practices, an examination of Indian offshoring practices was expected to be insightful. This study, then, addresses the following research questions:

1. ***Requirements Changes*** - What is the impact of requirements change on success of requirements analysis in offshore global software development (GSD)?
2. ***Control*** - What is the relationship between formal modes of control and requirements analysis success in offshore GSD?
3. ***Task-related Process Facilitation*** - What is the relationship between process facilitation by site-coordinators (client/vendor) and requirements analysis success in offshore GSD?

To address these research questions, an industry survey was conducted with 45 Indian IT provider organizations. The list of organizations is presented in Appendix 1. Responses from 115 IS professionals engaged with offshoring projects at various levels in these firms is presented herein. In the next few sections, we first present the extant literature, theoretical development, and conceptual model underlying this study. This section also presents the research hypotheses examined in this study. Subsequently, research methodology, analysis, and results are presented. The study concludes with a discussion of the findings, limitations applicable to the study, and implications for theory and practice.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Requirements Analysis Success in Offshore GSD

The contribution of effective requirements analysis to IS *project* success is inarguably well-established (Brooks 1975; Browne and Rogich 2001; Kaiser and King 1982; Byrd et al. 1992; Robey et al. 1993; Urquhart 2000). Most existing studies suggest two factors as critical to successful requirements gathering: (1) the nature and degree of interaction between analyst and users (Marakas and Elam 1998), and (2) coherent, consistent, and well-elaborated representation of requirements using well-defined artifacts (Byrd et al. 1992; Hoffer et al. 2005; Yadav et al. 2009). These success factors are now also well-accepted best practices for offshored projects for several reasons. Foremost, maturation of offshore software development through deployment of normative process maturity models such as Capability Maturity Models (CMM) (Ramasubbu et al. 2008) has resulted in proactive use of standards to reduce project risks and variation, increase budget adherence, and enhance IS team capabilities (Gopal et al. 2002), thereby enabling project teams to standardize offshore development practices. Further, similar maturation in client-provider relationships have facilitated common processes to better manage redistribution and offshoring of strategic and critical aspects of client functions (Davis et al. 2006; Wang et al. 2008). Finally, a shortage of skilled IT personnel in client nations, and resulting dependence on provider firms even for requirements gathering, has forced client-vendor teams to convene around shared artifacts and their standardized use.

The challenge, however, lies in the issue of volatility in offshore software requirements, the management of which challenges software teams beyond well-understood standards. As projects increase in complexity and scope, early requirements gathering often proves to be inadequate for offshore teams that may need to sustain dialog with on-site clients or facilitators to uncover changing specifications (Gopal et al. 2002; Vlaar et al. 2008). Successful

CONTRIBUTION

This paper makes a contribution to the IS literature in three ways. First, to our knowledge, this study is one of few that examines the success of the requirements analysis phase as opposed to project success in the context of offshore global software development (GSD). Considering that poor requirements gathering has consistently been identified as one of the top five reasons for project failure, and that offshoring of early phases of the GSD has been on the rise, this deficiency of attention to requirements gathering success is surprising. Second, the study examines effectiveness of formal control practices and process facilitation on the success of offshore requirements gathering between client-vendor teams. Both control and process facilitation are designed to regulate patterns of interaction between project teams, thereby enhancing team performance and delivery. Most prior literature has examined control and facilitation between IS teams and project managers. This study extends the literature to offshore client-vendor teams. Finally, our findings are based on IS professionals from 45 Indian IT firms. India is the largest IT service-provider nation. Its offshoring practices are mature and are reflective of industry best practices. To the best of our knowledge, this is the first study to examine perceptions of Indian IT providers regarding control and facilitation in offshore GSD.

Results confirm that although Indian providers view changes in client requirements as having a negative effect on requirements analysis success, formal control and process facilitation are beneficial in managing these effects. Specifically, process facilitation by client site-coordinators/liaisons is understood by Indian IT vendors to more greatly influence requirements analysis success than facilitation by vendor site-coordinators/liaisons. More interestingly, process facilitation is found to have an indirect effect on requirements outcome as facilitation is perceived to result in greater control, which in turn is perceived to lead to more success during requirements analysis.

management of this phase can enhance perceptions of success that begin with but extend far beyond the requirements stage. Client and vendor satisfaction with the requirements gathering process can serve as an early stage-gate checkpoint for project progress. Dissatisfaction with this process can force project teams to reconsider their approach to GSD process management and make early modifications. Finally, assessing requirements gathering success may cue project teams to reexamine their current requirements before they take on a different scale in later project phases (Bhat et al. 2006).

Yet, factors facilitating successful offshoring of initial software development phases have received limited attention (see, for example, Yadav et al. 2009; Jarvenpaa and Ji-Ye 2008). That is, although IS research has effectively uncovered the relationship between requirements analysis and *project* success, little focus has been given to assessing the relationship between requirements gathering practices and perceived *requirements gathering* success. As such, deeper research is needed to understand how GSD teams may be better prepared for challenges associated with gathering and managing requirements remotely (Sinha et al. 2006; Yadav 2011). To support this need, in this study, we adapt and extend measures of project success (Mahaney and Lederer 2006; Baroudi and Orlikowski 1988) to assess perceptions of requirements success as our outcome variable. The measures are discussed in later sections.

Control Theory: Formal Modes of Control

GSD project teams are often made up of individuals representing the business and IT staff of the client firm as well as offshore and onshore technical and analyst teams from the vendor firm (Bhat et al. 2006). Control theory describes how one person or group, the *controller*, ensures that another person or group, the *controlee*, works for and accomplishes the desired organizational goals. By regulating patterns of interaction, control attempts to increase the probability that team members will behave such that goals are achieved as necessary (Flamholtz et al. 1985; Henderson and Lee 1992). Controllers exercise two modes of formal control: behavior and outcome (Kirsch et al. 2002; Ouchi 1977; Eisenhardt 1985). In *behavior control*, appropriate steps and procedures for task performance are defined by controllers. Controlees' performance is evaluated on the extent to which they adhered to those prescribed procedures. In *outcome control*, controllers delineate appropriate targets and allow controlees to choose how to meet those desired targets (Kirsch et al. 2002). Performance of controlees is assessed on the degree to which targets are met, but the *processes* used to achieve these targets are not assessed. Aside from these formal control mechanisms in GSD settings, informal modes of control such as self-control and clan-control (Ouchi 1980), which require no formal incentives, are often influential in engaging with offshore project teams (Narayanaswamy and Henry 2005).

Control behaviors have further been examined in light of control structures. Teams may demonstrate centralized control such as that implemented in programming teams with the chief programmer executing formal control. Alternatively, control could be diffused within the entire team with decision making and communications being executed across a larger group of team members (Mantei 1981). Henderson and Lee (1992) examine control along the dimension of managerial control and team control and find that both types co-exist. Control can also be expressed by client liaisons to their offshore development teams (Kirsch et al. 2002).

Performance in IS teams is positively correlated with increasing control (Henderson and Lee 1992; Snell 1992; Eisenhardt 1985; Kirsch et al. 2002). Where it is possible to measure project outcomes, managers exert outcome controls more frequently (Snell 1992; Kirsch et al. 2002) but shift to behavior controls when behaviors are perceptible and when the development process is well understood (Kirsch et al. 2002). Client liaisons are less likely to exercise control in their superior-subordinate relationship with development teams, and when such control is exercised, it is most often done to align the project with organizational goals (Kirsch et al. 2002).

Recent studies that have focused on control and facilitation in outsourced projects have found interesting results when comparing internal and outsourced projects. Even though controllers may exert more control in outsourced software projects relative to internal projects, control is found to enhance project performance only on internal, as opposed to outsourced, software projects (Tiwana and Keil, 2009). These results are partly confirmed in a Japan–China offshoring context by Mao et al. (2008), who found that controls exercised by clients over their vendors improved project cost control by preventing vendor cost overruns but did not have a significant impact on outsourced project quality.

Of greater relevance to this study are conclusions regarding the sort of controls exercised in offshore contexts. There is some agreement that formal control modes, as opposed to informal controls, are most often used for outsourced projects to manage greater uncertainty (Rustagi et al 2008) and higher transaction hazards and risks (Tiwana and Keil, 2009) of outsourcing engagements. Offshore teams also do not have social and structural factors necessary for mitigating such risks to the same extent as internal project teams do (Lacity and Rottman, 2008).

Further, until client teams build trust in the knowledge and work ethics of their offshore vendor teams, such formal controls may predominate client-vendor interactions (Choudhury and Sabherwal, 2003; Tiwana and Keil, 2009). Such trust, which gradually evolves through extended interactions, will not be evident in early project stages, underscoring the need for formal modes of control in requirements determination. For these reasons, in this study we focus on formal modes of control within the Indian GSD context and propose the following hypothesis:

> ***HYPOTHESIS 1 (H1):*** *Formal modes of control positively affect requirements analysis success in an offshore GSD environment.*

Process Facilitation: Extending Control Theory

Control modes can be applied to content as well as processes related to group work (Miranda and Bostrom 1999). Content facilitation entails direct participation by the liaison in the decision or problem being resolved. Because content facilitation by the liaison is likely to suppress team participation, the primary role of such site-coordinators is recommended to be process facilitation (Miranda and Bostrom 1999). Process facilitation is defined as the provision of procedural structure and general support to groups (Eden 1990; Miranda and Bostrom 1999), with explicit or implicit ways of structuring control (Crisp 2003). In group decisions, process facilitation has been found effective for coordinating team efforts, such as by creating a productive meeting process (Anson et al. 1995; Miranda and Bostrom 1999).

Process facilitation can be provided by assigning liaisons/site-coordinators at both client and vendor locations in offshore GSD projects (Ramesh et al. 2006). Such liaisons can be instrumental in achieving success in a flexible GSD setting (Yadav et al. 2009) as they play a pivotal role in sensing and responding to emergent problems on a real-time basis (Lee et al. 2006). Effective liaisons and interaction processes at client and vendor interfaces are crucial for fine-tuning control practices towards project objectives (Gopal and Gosain, 2010). Vendor project leader characteristics such as cultural values (Rai et al 2006) and support practices (Thong et al 1994), and project coordination capabilities such as planning, governance, and team management (Kraut and Streeter, 1995; Crowston and Kammerer, 1998) influence client-vendor relationships and, in turn, project success. Such individuals are often critical boundary spanners (Gopal and Gosain, 2010) who enable global teams to overcome challenges of global collaboration. They also support translation of business requirements to technical teams while translating technical progress to their clients. With the underlying assumption that formal control mechanisms will dominate offshore relationships, particularly in the early stages of requirements gathering, we hypothesize:

> ***HYPOTHESIS 2a (H2a):*** *Process facilitation by a vendor site-coordinator will positively affect requirements analysis success in an offshore GSD environment.*

> ***HYPOTHESIS 3a (H3a):*** *Process facilitation by a vendor site-coordinator will positively affect formal modes of control during requirements analysis in an offshore GSD environment.*

Numerous studies have highlighted the necessity of shared and synergistic coordination between client and vendor teams (Rai et al 2006; Tiwana & Keil, 2009). In conjunction with vendor liaison capabilities discussed earlier, client characteristics such as IS capabilities and knowledge (Goles, 2001), business-related IT experience (Willcocks and Kern, 1998), technical knowledge (Rustagi et al 2008), and relationship management knowledge (Koh et al 2004) influence the nature of client-vendor relationships. A technically competent client, for instance, may jumpstart the project by providing evolved and clearly modeled requirements to the vendor (Rustagi et al 2008). Through effective monitoring and control, such liaisons may provide timely and relevant feedback in the requirements stages. As such, process facilitation by client liaisons has the potential of enhancing requirements gathering success. Based on these prior findings, we propose complementary hypotheses for client liaisons as:

> ***HYPOTHESIS 2b (H2b):*** *Process facilitation by a client site-coordinator positively affects requirements analysis success in an offshore GSD environment.*

> ***HYPOTHESIS 3b (H3b):*** *Process facilitation by a client site-coordinator positively affects formal modes of control during requirements analysis in an offshore GSD environment.*

These hypotheses reinforce the potential influence of process facilitation as a control structure for requirements analysis success in GSD (Yadav et al. 2009). As such, these hypotheses expand the role of control theory in offshore requirements gathering.

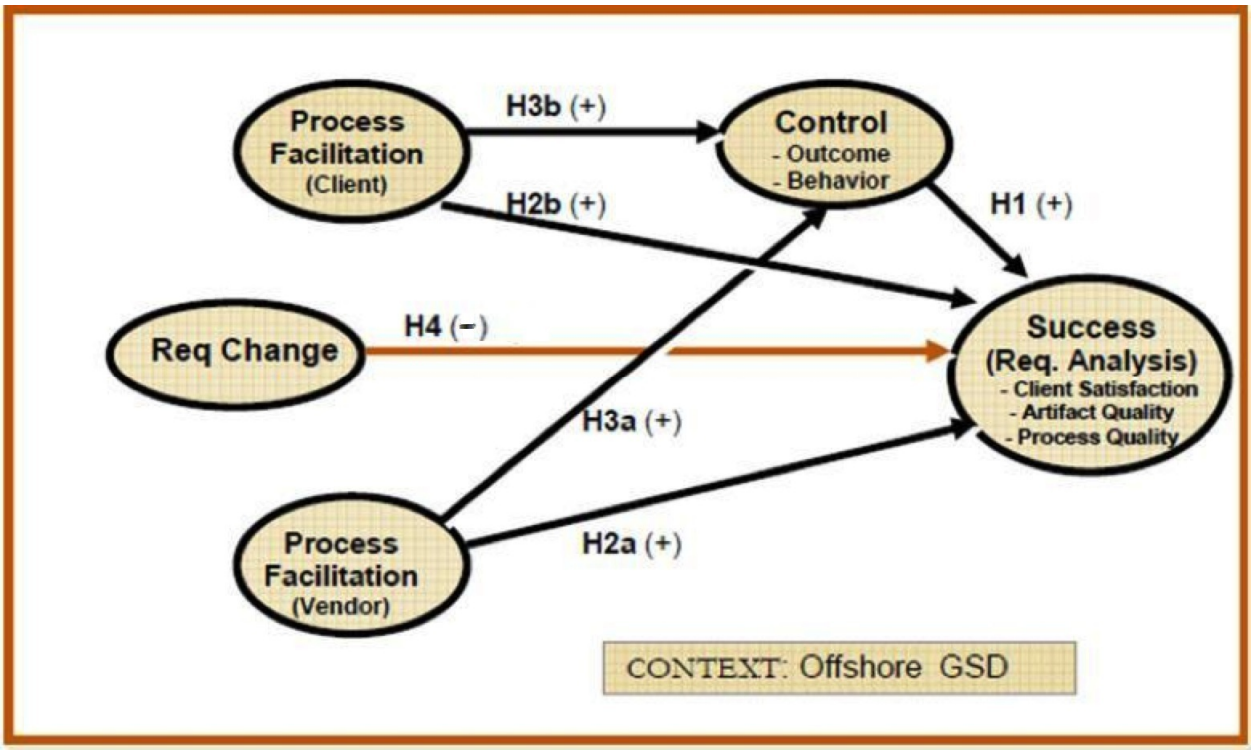
Traditional development approaches, often called waterfall, assume that requirements can be fully specified and are largely stable (Fruhling and Vreede 2006; Nerur et al. 2005). This assumption possibly drives the need for formal and informal controls such that tightly managed requirements gathering could minimize costly rework at later stages of the waterfall life cycle. At a fundamental level, process control and facilitation during requirements determination are designed to ensure that client needs are rapidly and correctly captured as stronger working relationships are still being established. Control and facilitation may allow liaisons to better coordinate issues emerging from changing requirements.

In the offshore GSD environment, few studies have empirically examined the effects of changing requirements on project success or failure (Fruhling and Vreede 2006), even though several studies have suggested the need to manage requirements in offshore GSD projects (e.g. Yadav 2011). In this study, we posit that changing requirements are likely to lead to greater rework in offshore GSD. Thus, they are likely to have a negative impact on the perceived success of requirements analysis. Therefore, we propose:

> ***HYPOTHESIS 4 (H4):*** *Changes in requirements negatively affects requirements analysis success in an offshore GSD environment.*

Figure 1 presents the research model and hypothesized relationships that have emerged from our theoretical development.

Figure 1: The Proposed Research Model.



INDUSTRY SURVEY DESIGN AND DEVELOPMENT

Survey methodology was used in this study to test the model and related hypotheses. An industry survey was carried out with a target population that included project managers, team leads, and analysts at an IT outsourcing service provider locations in India. As such, the survey captured perceptions of IT professionals who had experience in requirements analysis for offshore software development. The target sample for the survey was obtained from NASSCOM's list of Indian IT provider firms. The scope spanned provider firms from Indian cities that are major outsourcing office locations: New Delhi, Gurgaon, Noida, Bangalore, Hyderabad, and Pune.

IT organizations in Delhi, Gurgaon, and Noida were contacted in person to solicit study participation. Firms in Bangalore, Pune, and Hyderabad were contacted via email and phone. Nonprobability judgmental sampling was

used, which relies on the personal judgment of the researcher rather than on chance. Participants with at least one year's experience in requirements analysis in offshore GSD were invited to participate in the study, with an assurance of complete confidentiality. A total of 120 respondents from 45 IT provider firms participated in the survey (Appendix 1). Non-disclosure agreements with provider firms limited our ability to gather demographic, project, or client-related information from respondents. As participation was voluntary, we relied on respondents' willingness to provide useful responses. Furthermore, our sample population was largely composed of IT managers and liaisons who were in client-facing leadership roles and were most suited to respond to our questionnaires. The respondents were asked to select any recent project of their choice in which complete or a significant portion of requirements analysis was executed at the offshore location. Upon completion of data collection, five survey responses were identified as incomplete and were dropped from the analysis, yielding a usable sample of 115.

Survey Instrument Design

Existing measures from the IS literature were used to develop the survey instrument for the proposed model. Items that did not load well were removed from the analysis. The final survey items, including demographic items, are provided in Appendix 2. All items were measured on a 7-point Likert-type scale, where 1 measured strong disagreement, and 7 measured strong agreement. These measures are briefly discussed next.

***Requirements Analysis Success*:** IS research has examined success as aggregates of two or more factors, with the general consensus that there is no single measure for IS project success. DeLone and McLean (1992) proposed success measures that considered system quality, information quality, user satisfaction, individual impact, and organizational impact to define project success. Mahaney and Lederer (2006) later developed three dimensions of IS success that overlap greatly with DeLone and McLean (1992): client satisfaction, perceived quality of the project, and success with the implementation process. Yadav et al. (2009) adapted Mahaney and Lederer's (2006) measures to evaluate perceived success with the requirements analysis phase by capturing (a) client satisfaction with the requirements phase, (b) perceived quality of requirements deliverables, and (c) perceived success of the requirements process. Considering the focus of this study, this last conceptualization of requirements analysis success was adopted.

***Control*:** Items for measuring formal modes of control have been well established and validated in numerous prior studies. Specifically, measures developed in earlier studies by Kirsch (1997), Kirsch et al. (2002), Piccoli et al. (2004), and Yadav et al. (2009) were used.

Process Facilitation: Items for this construct were adapted from Group Support Systems (GSS) literature on process facilitation (Miranda and Bostrom 1999; Anson et al. 1995). These measures were enhanced with items from constructs developed specifically for the offshore context by Yadav et al. (2009).

Requirements Change: Three items measuring the frequency and scope of changes in requirements were developed for this construct. These items were first pilot tested in an academic offshore GSD project involving 102 respondents to check for reliability (Cronbach's alpha > 0.7) before inclusion in the survey instrument.

Offshoring: Degree of offshoring was entered as a control variable in the model to statistically control for the varying levels of requirements offshoring occurring in the industry. This item was measured on a scale of 1 (0% requirements analysis executed offshore) to 6 (100% requirements analysis executed offshore).

Flexibility: This was used as a control variable to statistically control for varying levels of flexibility in the development approaches followed in the industry. Flexibility was measured on a scale of 1 (highly flexible, having no requirements planning, no formal processes for requirements analysis, no documentation, and smaller team size < 15) to 7 (highly rigid, having very formal requirements planning, very formal processes and standards for requirements analysis, extensive documentation, and larger team size > 15). This measure was created from existing literature on flexible development approaches spectrum in GSD (Yadav et al. 2007; Yadav et al. 2009).

FINDINGS FROM SURVEY ANALYSIS

The unit of analysis for this study was the individual with reference to a specific project. Effects of predictor variables on the outcome variable as perceived by the individual were measured. Structural equation modeling (SEM) with AMOS version 7 was used for analysis. A common practice used in conducting SEM analyses with latent variables involves creating "item parcels" based on sums or means of responses to individual items and then using scores on these parcels in the latent variable analysis (Russell et al. 1998). In using item parcels, results of the analysis are less likely to be distorted by idiosyncratic characteristics of individual items (Russell et al. 1998). Parcels were also created for success and control based on means (Kline 2005) for SEM analysis.

For reliability analysis, Cronbach's alpha values for items above 0.7 were considered acceptable (see Table 1). In SEM, we first tested the measurement models (confirmatory factor analysis - CFA) to evaluate construct validity (Straub et al. 2004). Hypothesized SEM models for the survey were tested next. Overall, fit statistics indicated acceptable fit (see Table 2 for fit values).

Table 1: Reliability Analysis

Latent Variable	No. of Items	Cronbach's Alpha
1. Req. Change	3	0.720*
2. Control	6	0.779*
3. Process Facilitation (Client)	2	0.854*
4. Process Facilitation (Vendor)	2	0.743*
5. Success (Req. Analysis)	8	0.799*

* Reliability Analysis (Cronbach's alpha) > 0.7

Table 2: Measurement Model Fit Summary

Model Fit Measures	Model Value	Acceptable Value
Goodness-of-Fit Index (GFI)	0.907*	> 0.9
Incremental Fit Index (IFI)	0.938*	> 0.9
Tucker-Lewis Index (TLI)	0.902*	> 0.9
Comparative Fit Index (CFI)	0.935*	> 0.9
Root Mean Square Error of Approximation (RMSEA)	0.048*	< 0.05

* Significant model fit values (Byrne, 2001)

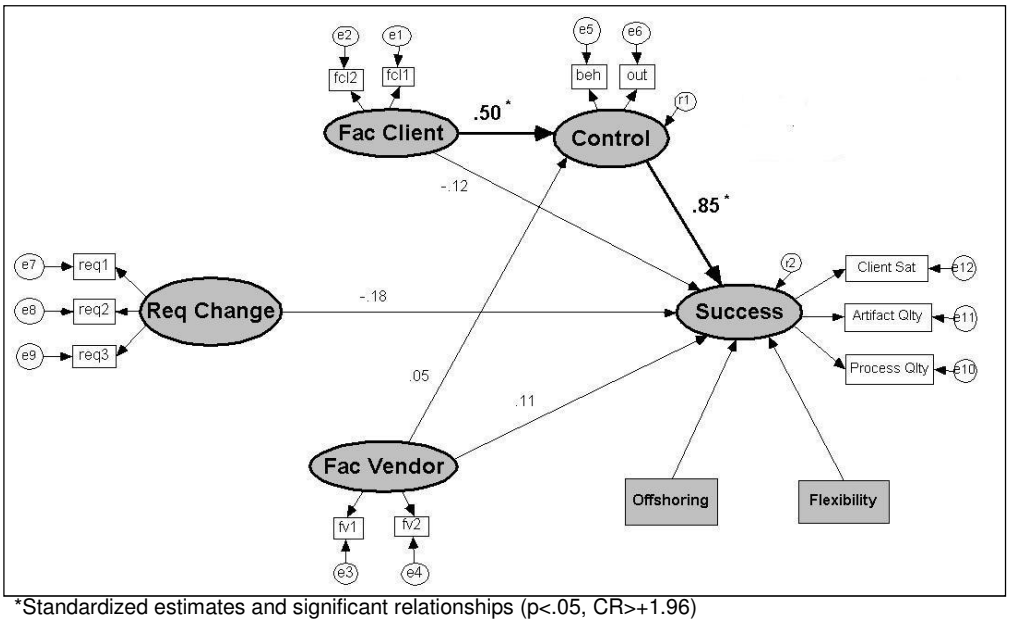
Procedures specified by Byrne (2001) were used to estimate the hypothesized SEM for the survey. Figure 2 presents the structural model for standardized regression weights associated with the hypothesized paths. There are three exogenous latent variables: requirements change, process facilitation by vendor, and process facilitation by client. There are also two endogenous latent variables: control and requirements analysis success. The two control variables for degree of offshoring and flexibility in development approaches were also included. Table 3 summarizes the results of the individual hypotheses.

DISCUSSION

Impact of Control on Requirements Analysis Success

Findings from this study show a strong positive impact of control (both behavior and outcome) on requirements analysis success in offshore GSD projects (Hypothesis H1). As only formal control was examined, results confirm that the imposition of structure through formal control positively affects success during requirements analysis. As most prior studies have primarily focused on controls in internal software projects, our study is one of few to confirm early suggestions by Choudhury and Sabherwal (2003) that outcome control in outsourced IS projects resembles that of internal IS development projects. Interestingly, these results are contradictory to findings by Tiwana and Keil (2009), who suggest that controls enhance performance in internal projects but not in outsourced projects. Our findings may provide early support for the supposition that the various phases of software development may benefit differentially from formal and informal control mechanisms, and that the use of these controls must mature with the project. As one of the earlier phases of software development, requirements determination may not gain from client-vendor trust, which builds gradually through extended engagement. Coupled with the precision and communication demands of this stage, offshore requirements success may be more critically dependent on formal controls than was previously understood.

Figure 2. Structural Equation Model



*Standardized estimates and significant relationships (p<.05, CR>+1.96)

Table 3: Summary of Industry Survey Results

Hypo-thesis	Path	Hypothesized Relationship	Path Coefficient (Std. beta)	Critical Ratio (CR>±1.96)	Sig. (p<.05)	Hypothesis Supported?
H1	Control → Req. analysis success	+	0.849*	4.291*	.000*	**Supported**
H2a	Process facilitation (vendor) → Req. analysis success	+	0.108	0.885	.376	Not supported
H2b	Process facilitation (client) → Req. analysis success	+	-0.123	-0.811	.417	**Supported indirectly** (indirect effect on success mediated via control)
H3a	Process facilitation (vendor) → Control	+	0.046	0.329	.742	Not supported
H3b	Process facilitation (client) → Control	+	0.501*	3.668*	.000*	**Supported**
H4	Req. change → Req. analysis success	-	-0.185	-1.874	.061	Not supported

*Standardized estimates and significant relationships (p<.05, CR>+1.96)

Impact of Process Facilitation on Requirements Analysis Success

Process facilitation by client site-coordinator had greater bearing on requirements analysis success as opposed to that by vendor site-coordinators. However, this positive impact of client site-coordinator on requirements analysis success (Hypothesis H2b) was supported indirectly. Specifically, process facilitation provided by client site-coordinators led to increased control (Hypothesis H3b), which in turn enhanced perceived project success. These findings confirm those by Ramasubbu et al (2008), who suggest that client firms' investment in structured processes and process-based learning activities with offshore providers can counter the challenges of distributed development and improve opportunities for project success. This has interesting implications for client readiness for offshore engagements. Many challenges in offshore projects are often experienced in early, and often most critical, stages of projects because client-vendor processes are misaligned (Lacity and Rottman, 2008). If client organizations can

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invest early in formalizing and aligning offshore engagement processes, early determinants of project success may be leveraged.

Hypotheses H2a and H3a, examining the impact of process facilitation by the vendor site-coordinator, were not supported in the survey. Follow-up discussions with industry experts suggested that survey respondents from service provider firms considered vendor site-coordinators to be present by default in offshore projects. Therefore, it is likely that the importance of their own site-coordinators was overlooked by vendor teams. On the other hand, in project settings, not all client team members are usually in direct contact with the analyst/developer team members at offshore locations. Consequently, the role of client site-coordinator in facilitating control takes on greater significance as he or she acts as a point of contact for offshore provider teams. That said, our survey was from the perspective of vendors located in India and as such did not capture the client perspective. Greater insights may be obtained by examining the client perspective.

Impact of Requirements Change on Requirements Analysis Success

Requirements changes result in rework during the development phase, which most often requires increased documentation and can increase the need to manage conflict and negotiation. Considering this, then the perceived success of the requirements phase is likely to be minimized by the complexity of these reworks. However, we did not find a significant negative relationship between requirements change and requirements analysis success. Possibly, frequent requirements changes in early stages may be viewed as leading to improved clarity on the project outcome, offsetting the negative demands of increased documentation, negotiation, and change management. These specific effects, however, need to be examined further, possibly in context of specific projects, as they can have differential impact on project processes and subsequent success.

IMPLICATIONS AND CONCLUSIONS

Implications for Practice

Offshoring of early GSD phases is becoming increasingly commonplace as corporations seek to take advantage of geographically dispersed talent for multi-location operations. As client nations face a growing IT talent shortage, organizations may be compelled to consider offshoring of early GSD phases. IT provider firms like Sapient have demonstrated the ability to run complex, large-scale distributed projects and have leveraged benefits of flexible processes (Barnett 2006) to acquire requirements successfully. Results from our industry survey also revealed an organization, Theikos, that has successfully delivered projects in 'total' offshore mode. To this end, survey results confirm our initial assumption that requirements offshoring is increasingly expanding in the Indian IT industry. This study yields several implications for practice that can assist organizations in managing early phases of offshore GSD projects more effectively.

The findings provide preliminary evidence on practices that client as well as provider firms can incorporate discipline in offshore GSD projects during requirements analysis. First, using the stage-gate approach, client firms must actively measure and manage requirements analysis processes in early project phases. Given the strong influence of effective requirements on system success, metrics designed to measure requirements success may be beneficial in predicting project success. Second, when offshoring requirements analysis phases, client firms must proactively design control and facilitation procedures with their own coordinators playing a critical role in engaging with offshore vendor teams. We also find that firms engaged in offshore GSD have developed strong processes around their GSD mode, and that client site-coordinators play a critical role in increasing requirements analysis success. As such, clients could play a more active role in enhancing the perceived image of vendor site-coordinators who, according to our findings, are not considered significant for requirements success. Finally, we did not find significant empirical support for the negative effects of requirements change on success in the early phases of software development. However, the nature and extent of requirements change must be further examined before deriving any conclusions.

Implications for Research

In contributing to the existing body of knowledge, this study empirically examined direct and indirect relationships between antecedent factors (control, process facilitation by site-coordinator, and requirements change) and success. More significantly, it extends past research by examining antecedents of requirements analysis success in a field setting based on findings from the Indian software industry.

The industry survey was conducted from the Indian vendor perspective only. It calls for further research to investigate client perspectives in client nations such as the US, the UK, and Japan. Further, this study can be extended to other vendor nations such as China, Ireland, and Russia for an enhanced cross-national comparison.

We also did not consider any cultural dimensions, such as those proposed in Hofstede (1980) or House et al (2002), to examine cultural manifestations of control and facilitation. For instance, India's high power distance orientation may explain why client site-coordinators may be perceived to play a more crucial role in process facilitation and control than on-site development liaisons do. The former may be considered more influential members of the organizational team than the latter, thereby attributing greater power to client site-coordinators. Researchers may consider the model proposed by Rai et al. (2009) to extend aspects of this study to considering cultural effects in control and process facilitation.

Findings from the survey highlight the key role that formal modes of control play in offshore requirements analysis. The scope of our research was limited to only formal modes of control, whereas offshore GSD can also incorporate informal modes of control such as self and clan control (Kirsch 1997). Rustagi et al (2008) suggest that when client and vendor organizations have better relationships and trust, they may use lower formal control. Future research may focus on understanding the conditions under which informal modes of control (self and clan control) are used in offshore projects, and the impact of these informal mechanisms on success across the various phases of the project. In conformance with behavior continuum theory, interesting results may also emerge from examining formal and informal control by project phases where teams may find use of formal controls beneficial in early project phases but may shift to informal control in later phases. Existing control studies also suggest that behavior control entails monitoring behavior that is explicitly as well as implicitly prescribed. These explicit and implicit behaviors were not examined in our study and might yield insights into which behaviors are more effective. This is particularly relevant in an environment where the industry seems to be shifting proactively towards flexible methods that often have implicit controls as team norms. As such, implicit/explicit manifestations of control require further investigation.

Our research is one of the first studies to empirically investigate the impact of requirements change on requirements analysis success. However, the constructs used in this study may benefit from replication and extension. For instance, the two facets of requirements change—magnitude and frequency—could be enhanced to attach greater depth to the construct. Additionally, the construct does not examine dependencies among project phases. For instance, requirements changes are likely to affect other phases of a software project. Such dependencies have not been examined in this study. Furthermore, for several of our measures, we created item parcels based on mean. Although the use of item parcels has the potential of reducing distortions by idiosyncrasies of individual items, it does reduce the number of item scales for SEM analysis and complicating interpretation of Cronbach's scores. Finally, this study has not explored whether the increase in formal control has any impact on the negative influence of changes in requirements. Possibly, changes in project parameters triggered by changing requirements may be better managed using formal control. In contrast, such changes may require the teams to be creative in their response, and formal controls may restrict the free flow of such creativity. These effects are unexplored in our study, but each provides productive avenues for future research.

Considering the range of provider firms in India, there are likely to be differences in the manner in which small, mid-size, and large provider firms manage relationships with client organizations. Their performance and relationships may also vary by quality certification levels (like CMM) of the firm, as Level 4 and 5 CMM firms may be expected to have more formalized practices for requirements control and relationship management. This can be an interesting extension of future research, where firms classified by level or size can be compared with regards to their control, facilitation, and requirements change practices.

Our study has largely focused on the perceptions of managers. However, even though a software project may have a positive outcome, if developers end up handling numerous revisions and changes during the course of development, their perceptions of control and process facilitation may not be as positive as those of managers who may focus on project outcome rather than project processes. Because of our emphasis on managerial roles, these differences are not explored in our study, but they offer a fertile area for future research.

Finally, this research has emphasized the contribution of formal control in requirements gathering success. Individual and team factors, however, can potentially affect the requirements analysis success of offshore projects and as such can provide interesting insights into control and process facilitation among site-coordinators and team members. We offer this as a potential area for future research, as informal relationships certainly shape outcomes of software projects. Studies may consider moving beyond the currently conceptualized variables to include variables such as impact of motivation, attitudes, cohesion, and trust between offshore GSD team members and emotional intelligence of individual team members.

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APPENDECIES

APPENDIX 1: List of Organizations

No.	ORGANIZATION	No. of Responses
1	Agilent Technologies	1
2	Agilis International	1
3	Airvana Networks	1
4	Alcatel-Lucent	2
5	Aricent	7
6	Avaya Global	1
7	CMC	2
8	Colt	1
9	Covansys	2
10	EDS	2
11	Evalueserve	1
12	Fidelity	1
13	Globallogic	2
14	HCL Technologies	8
15	HeadStrong	1
16	Hewitt Associates	3
17	Hughes Software Systems	2

No.	ORGANIZATION	No. of Responses
18	IBM	9
19	I-Flex Solutions Ltd.	1
20	Infosys	4
21	Ismart Panache	1
22	Kanbay India Pvt. Ltd.	2
23	Keane	4
24	Navisite	1
25	NIIT Tech.	3
26	Orange Business Services	2
27	Safenet Infotech	1
28	Sai Info Limited	1
29	Sapient	9
30	Sirus	1
31	Satyam Computer Services	3
32	ST Microelectronics	1
33	Tavant Tech.	3
34	TCS	8
35	TechMahindra	2
36	Techspan	1
37	Theikos	3
38	Unisys India Pvt Ltd	2
39	Value One Infotech Pvt. Ltd.	1
40	Wipro Technologies	2
41	OTHERS (5 Organizations)	13
	TOTAL RESPONSES FROM 45 ORGANIZATIONS	**115**

APPENDIX 2: Questionnaire Items Used in Industry Survey

Response Scale: "Please answer each of the following questions related to globally distributed requirements analysis by circling the appropriate response." Seven point scale, with 1= "Strongly Disagree," 4= "Neutral," and 7= "Strongly Agree"

REQUIREMENTS ANALYSIS SUCCESS

Item	Item Parcel: Client Sat
s1	The client was highly involved with our team during the requirements gathering process.
s2	The client clearly understood the requirements deliverables submitted by our team.
s3	The client was highly committed to the goals and tasks of requirements phase.
s4	The requirements deliverables were readily accepted by the client.
	Item Parcel: Artifact Qlty
s5	Our requirements phase deliverables adequately covered client requirements.
s6	Our team has been able to accurately capture and document requirements.
	Item Parcel: Process Qlty
s7	The requirements were captured within the original time schedule.
s8	The client was satisfied with the process by which the requirements were captured.

REQUIREMENTS CHANGE

req1	We did not have any changes in requirements during the requirements phase.

req2	The level of requirements change was high during the requirements phase
req3	There were frequent changes in requirements during the requirements phase.

PROCESS FACILITATION

Did your client have a dedicated liaison at the client site*—for example, a client representative who acted as a point of contact for your team?* If yes, please answer the questions below. Otherwise proceed to question number Z

Item	Process facilitation by client site-coordinator
fcl1	During the requirements phase, the *client liaison* helped coordinate the workflow between client and our team members.
fcl2	During requirements gathering, the *client liaison* constructively responded to our team's needs for assistance.

Did your team have a dedicated liaison here in India for the client*—for example, a project manager or a team lead or a team representative who acted as a point of contact?* If yes, please answer the questions below. Otherwise proceed to question number X

Item	Process facilitation by vendor site-coordinator
fv1	During the requirements phase, *our liaison* helped coordinate the workflow between client and our team members.
fv2	During requirements gathering, *our liaison* constructively responded to our team's needs for assistance.

CONTROL

Item	OUTCOME CONTROL (Item Parcel: out)
out_cnt1	The client insisted on complete and on-time submission of project status reports during the requirements phase.
out_cnt2	The client insisted on complete and on-time submission of requirements deliverables.
out_cnt3	The client insisted on timely completion of requirements phase.

Item	BEHAVIOR CONTROL (Item Parcel: Beh)
beh_cnt1	The client regularly monitored the progress of requirements phase.
beh_cnt2	The process for communication between client and our team members was well defined.
beh_cnt3	A project management plan *(specifying schedules, deliverables, milestones, roles, etc.)* was developed for capturing and documenting requirements.

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