Managing Outsourced Software Projects: 
An Analysis of Project Performance and Customer Satisfaction

Revised Version

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We examine the drivers of project performance and customer satisfaction in outsourced software projects using a proprietary panel dataset. The data cover 822 customer observations related to 182 unique projects executed by an India-based software services vendor. Adopting a multidisciplinary perspective, we investigate how project planning, team stability, and communication effectiveness (antecedent variables) impact project performance and customer satisfaction. We delineate the direct and interactive influences of the antecedent variables. We also examine how these influences are moderated by two important project contexts: (a) the nature of software work (Maintenance & Development versus Testing projects) and (b) project maturity (New versus Mature projects). Among other results, we demonstrate that when project planning capabilities are high, the positive impact of team stability and communication effectiveness on project performance is even higher. In addition, our results suggest that the impact of communication on project performance is muted when team stability is high. Finally, we also demonstrate that the impact of the antecedent variables on project performance varies with the nature of software work. Our findings offer specific and actionable insights to managers that can help them manage outsourced projects better, and open up new research perspectives in the context of outsourced project management.

Keywords: Outsourcing, Software Projects, Project planning, Customer Satisfaction, Operations Management.

1. INTRODUCTION

Modern firms frequently leverage workforce skill sets, time differences, and differential costs to outsource business activities (Kulkarni 2009). The total global spending on information technology, including business process outsourcing (IT-BPO), was about $967 billion in 2008 (NASSCOM 2009). The annual revenues of the India-based IT-BPO services industry were estimated at $71.7 billion during 2009 (NASSCOM 2009). Despite the extensive growth of technology outsourcing, reports of customer dissatisfaction with the delivery of outsourced services have often surfaced in the popular press. According to McEachern (2005), “Fifty-one percent of respondents reported terminating an outsourcing contract. On the satisfaction side, 62 percent of respondents said they were satisfied with their outsourcing relationships, down from 79 percent a year ago.”

Creating and maintaining satisfied customers can help a company increase profits, and ultimately, shareholder value (Fornell et al. 2009; Fornell et al. 2006). The existing research on software outsourcing does not address issues related to customer satisfaction and project performance in outsourced projects (for a detailed literature review of IT outsourcing, see Dibbern et al. 2004). Against this backdrop, our research examines the following questions. How do antecedent variables such as project planning, communication effectiveness, and team stability influence project performance and customer satisfaction?
in outsourced software projects? How do task contexts related to the nature of work and project maturity moderate these influences?

Our work differs from the current literature on software projects in the following ways. First, there are no existing studies on the drivers of customer satisfaction in outsourced software projects (see Ramasubbu et al. 2008a for domains of existing customer satisfaction studies). Two related studies examine customer satisfaction in the software domain, but neither focuses on outsourced projects. Specifically, Ramasubbu et al. (2008a) examine how technical or behavioral skills of support personnel drive customer satisfaction in the context of enterprise software systems (ESS). Kekre et al. (1995) study user satisfaction with attributes of a software product. Further, outsourced software service providers have gradually moved beyond developing technical skills and have pursued a broader set of capabilities covering project management, communication, and turnover management (Ethiraj et al. 2005; Swink et al. 2006; Gopal et al. 2002). However, little is known about the pathways through which these capabilities ultimately drive customer satisfaction. Our work addresses these gaps in knowledge.

Second, the nature of work and the levels and kinds of uncertainties involved can vary across software project types (Cusumano et al. 2003). While some studies have examined the drivers of software project performance (e.g, Deephouse et al. 1996), evidence on how these drivers vary across project types is limited. Nidumolu (1995) examines how residual risk mediates the impact of communication on project performance. Barki et al. (2001) suggest that project performance is contingent on adequate fit between software development practices and project uncertainty levels. MacCormack and Verganti (2003) examine how requirement uncertainties in web development projects moderate the impact of development practices on performance. We add to existing insights by examining how the drivers of project performance and customer satisfaction vary by: (a) the nature of software task (Maintenance & Development versus Testing projects) and (b) project maturity (New versus Mature projects).

Third, in addition to these external contexts, the antecedent variables that affect project performance and customer satisfaction may also mutually moderate their impacts on these outcomes. To examine such influences, we examine the interactive effects of these variables on project outcomes.

Fourth, managing turnover is important for software projects in general, and for offshore software projects in particular (Gopal et al. 2003; Narayanan and Swaminathan 2007). Despite frequent discussions
in the trade press about the negative effects of turnover, there is little empirical evidence about how team
stability impacts software project performance and customer satisfaction. We explore this issue.

Finally, to the best of our knowledge, the related literature in the software domain has
consistently employed cross sectional data to examine project performance as a dependent variable. We
employ an estimation approach based on longitudinal data with multiple observations for each project.

In §2, we develop the theoretical perspectives that link key antecedent variables to customer
evaluations of project performance and overall satisfaction. Research design and measurement issues are
described in §3. The empirical findings and contextual effects are detailed in §4. In §5, we present the
managerial implications and limitations of our study, and describe some ideas for future research.

2. THEORY

Figure 1 outlines our conceptual model. We first consider the antecedents that influence customer
satisfaction. Next, we consider the antecedents that influence project performance. In developing the
hypotheses, we frequently draw on the structural contingency perspective (Miller 1992; Nidumolu 1995;
Barki et al. 2001) and the risk-based perspective of software development (Nidumolu 1995). In addition,
consistent with the interdisciplinary nature of our work, we also draw on the marketing and service
operations literatures to motivate our arguments.

---------------- INSERT FIGURE 1 ABOUT HERE---------------

2.1 Customer Satisfaction

Customer satisfaction is the evaluative response of the client to the services rendered by the
provider (Wirtz and Bateson 1999). While customer satisfaction can be modeled as a function of the gap
between client expectations and the service provider's performance (Berry et al. 1985), expectations may
be unclear in the context of complex software services and satisfaction may instead be based on
subjective client experiences with delivered services. Direct, customer experience-based measures of
satisfaction are appropriate in such scenarios (Rust et al. 1999). Such measures have been adopted in
other studies in technology-intensive service settings (e.g., Balasubramanian et al. 2003; Krishnan and
Ramaswamy 1999; Ramasubbu et al. 2008a). Accordingly, we measure customer satisfaction as the overall of satisfaction of the client with the service provider team.

Achieving high customer satisfaction is particularly challenging when services involve intensive customization, complex tasks, remote operations, and contract workers who can be influenced only to a limited extent (Stewart 2003). The outsourced software projects we study possess these characteristics. Against this backdrop, we can expect that, first, output timeliness and quality will comprise important components of overall delivery expectations and can positively impact customer satisfaction.

Second, when customers evaluate services, the interactions that lead to the final outcome may drive satisfaction in parallel with the outcome itself (Brown and Swartz 1989; Danaher and Mattsson 1994). These interactions are crucial in software projects because the priorities and emerging issues are often unclear to both customer and service provider. Project planning helps resolve such uncertainty through frequent exchanges of information that keep the customer continuously involved (Stewart 2003; Bendoly and Swink 2007). Further, because such planning allows the customer to be involved throughout, it can increase satisfaction through self-attribution effects (Konana and Balasubramanian 2005).

Third, communication effectiveness can enhance customer perceptions of delivered service quality (Berry et al. 1985). Further, effective communication can create customer confidence about the deliverables and provide reassurance that customer needs are being addressed. This is particularly important in a context where the development activity takes place in a distant, unfamiliar location.

Finally, customers often build strong relationships with individual service-provider employees in knowledge-intensive service domains. These relationships, which can develop customer confidence in the competence of specific individuals and lower perceptions of project risk, may even be stronger than the institutional relationship between the parties (Czepiel 1990). When personnel turnover does occur, customers are less dissatisfied if the replacement process is properly managed and if they have some input into the replacement process (Bendapudi and Leone 2002). Therefore:

**H1:** Project performance, project planning, communication effectiveness, and team stability have a positive effect on customer satisfaction.
2.2 Project Performance

Project performance is measured by the quality and timeliness of the team in meeting the expected deliverables. The literature on software project performance has been primarily anchored in the structural contingency perspective (Nidumolu 1995) and the risk-based perspective of software development (Barki et al. 2001; Nidumolu 1995). Underlying the former is an information processing view of the organization (Galbraith 1977). Intensive information processing and exchange can reduce the negative effects of uncertainty (Barki et al. 2001; Nidumolu 1995) and enhance project performance (i.e. the quality and timeliness of software delivery). In offshore outsourcing, relationships are characterized by the lack of frequent face-to-face encounters, time zone differences, and cultural divides – this enhances the role of effective communication (Wright 2005). Effective communication in the offshore outsourcing context involves two distinct facets. First, the service provider has to provide frequent, timely, and complete reports of project progress to the customer. Second, the service provider has to effectively articulate issues, many of which are technically complex and prone to multiple interpretations, through oral and written communication. Accordingly, communication effectiveness is determined by (i) communication intensity – as measured by the frequency and quality of reporting and (ii) communication ability – as measured by the ability of the offshore counterparts to articulate issues when interacting through conference calls or emails. Such communication skills are pivotal inputs into effectively managing the project and reducing customer’s perception of project uncertainty (Apte et al. 1997; Nidumolu 1995).

Effective communications can reduce uncertainty through multiple means. First, by providing a clear idea about customer needs and about the level, kind, and temporal scheduling of resources that would be required to meet those needs, such communications can induce superior customer perceptions of project planning (Gopal et al. 2002). Second, frequent and effective communications help the developer keep track of the shifting priorities of customers, and help align development resources to be responsive to the requirements of customers. Third, frequent and effective communications can help reduce the gap between the current state of the project and the customer’s desired trajectory.

Further, we expect that the positive influence of communication effectiveness will be accentuated when the team possesses strong project planning capabilities. Project planning can help manage
uncertainties through effective planning, estimation, and prioritization of project activities, and the
proactive management of potential problems within the project environment (Nidumolu 1995). These
uncertainties include: (a) changes in project requirements that can call for substantial and unanticipated
rework; (b) the implementation of promised changes in software specifications and functionality that call
for effort and time allocations that far exceed initial estimates; and (c) the implementation of features and
functionality that require expertise that may take longer to learn than expected (see Barki et al. 1993 for a
summary of risks). Effective communications enable timely and relevant knowledge sharing between the
parties and a sound understanding of mutual expectations. However, to ultimately effect project
outcomes, this information must be leveraged within a strong project planning process. Otherwise,
information that is generated through robust communications will not be effectively translated into
project-level decisions and actions that will ultimately impact the quality and timeliness of service
delivery. Therefore:

\[ H2: \text{Communication effectiveness positively impacts project performance, and this impact is higher when project planning capabilities are high.} \]

In knowledge-intensive work environments, productivity and work quality are impaired when
employees exit the team (Napoleon and Gaimon 2004; Narayanan et al. 2009). When teams are stable, the
service provider can adhere to planned estimates, execute work without disruption, and better manage the
changes in priorities – this enables superior project planning (Abdel-Hamed 1989). When turnover is
high, there is limited information about the new entrants’ capabilities (Höffler and Sliwka 2002) – this
leads to non-optimal work allocation and incorrect expectations. Second, the management of project
priorities is affected because experienced team members need to guide the new entrants up the learning
curve (Chapman 1998; Huckman and Staats 2009). Further, the knowledge resident in the departing
members, which is often of a tacit nature, has to be documented and absorbed by others within the team.
Finally, reduced stability decreases the team’s ability to recognize and manage sources of risk. New team
members are less likely to identify problems at an early stage, and are less capable of taking quick
remedial actions.

Team stability is likely to be particularly useful when project planning capabilities are strong.
Good project planning involves the proactive estimation and planning of work schedules. When project
planning capability is high, the presence of stable teams enables even better project performance. When
teams are stable, there is lesser uncertainty around the committed plans to the customer on account of the reliable pool of knowledge and capabilities available within the team. This enables the team to meet the planned deadlines, enhancing its credibility in the eyes of the customer. Finally, the presence of superior planning capabilities enables managers to better leverage the stable set of knowledge and capabilities embedded within the team to respond to disruptions and schedule slippages. Therefore:

**H3:** Team stability positively impacts project performance, and this impact is higher when project planning capabilities are high.

Cultural differences between service providers and customers can lead to communication problems in the context of offshore outsourcing (Kobayashi-Hillary 2005; Wright 2005). Engineers in software service firms often undergo intensive training to help them understand the customer’s native culture and associated social etiquettes (Abdel-Hamed 1989). However, communication skills are seldom well developed during a short training course or in a formal learning environment. Learning about the client culture and developing a communication style fits with the environment takes time (Torbiron 1982). Further, the engineers must develop the ability to communicate in a mutually understandable technical language that reflects knowledge about the customer’s software application domain and the way that domain maps into the software design (Curtis et al. 1988).

When teams are stable, the customer can form a close relationship with individual team members and better understand their communication patterns. Based on this knowledge of the service provider’s team, the customer can arrive at more confident estimates of the team’s ability to meet project goals. Correspondingly, frequent and explicit communication of mutual expectations and progress reports between parties may be substituted by an enhanced mutual understanding of requirements and commitments, and a shared trust that the parties will fulfill responsibilities at each end. In contrast, when teams are not stable, the parties have to engage in frequent and detailed communication to ensure that the correct expectations are set and that progress is continually tracked. In addition, when there is some team turnover, the service provider has to assure the customer counterpart that the task in hand is not affected due to the reallocation of activities, describe procedures implemented to minimize work disruption, and may sometimes even need to vet potential new team members with the customer. Therefore:

**H4:** The impact of communication effectiveness on project performance is lower when team stability is high.
3. **RESEARCH DESIGN**

3.1 **Research Setting and Data**

Our data are sourced from a large, export-oriented, India-based software services company with over 20,000 employees and over $500 million in annual revenues at the time of the study. The data were based on software projects that were executed by the firm for a single, large global client over multiple years. The service provider’s operations were consistent with the concept of a “dedicated” offshore center – all resources in the center served a single client. The center was certified at SEI-CMM Level 4 at the time of the study. Despite a common process framework, there was some variation in the implementation of quality processes across projects – this is consistent with other studies that have examined software engineering practices implemented under the SEI-CMM framework (e.g., Ramasubbu et al. 2008b).

As a first step, we spent two months at the service provider’s sites in India to interview managers, project leads, and quality supervisors. The facilitated a first-hand understanding of the key issues involved in project execution. In parallel, we collected data on customer satisfaction and productivity-related issues across multiple projects. We also learned about the nature of recruiting and training within the organization. Software engineers were recruited mainly straight out of undergraduate engineering programs. A small fraction of the engineers did not have a formal engineering background – instead, they held post-graduate qualifications in software programming or other technical areas. Some engineers were hired directly from competitors. Every engineer underwent introductory training that comprised a mix of technical, quality, and cultural training. In addition, the field work allowed us to examine the variation in project types managed by the firm and the operational measures in place to improve engineer productivity and manage turnover (new member entry and exit) in the project team.

Consistent with Kraut and Streeter (1995), a project in our context is defined as a group of members engaged in a specific software activity who report to a supervisor and have an associated project sponsor from the client side. Projects could focus on software development or maintenance and testing tasks, and could be located within the application or system software domains. Our definition of a software project is consistent with that of Wright (2005), who notes: “… (a) project could be anything from new development to the conversion of an existing application, support or maintenance… The outsourcing partner can contribute with any of the roles except the project sponsor role.” Our unit of
analysis is a single instance of an evaluation of an offshore project team by a client manager (sponsor). Each evaluation consists – among other variables – of the client manager’s ratings of project performance, project planning, communication, team stability, and overall satisfaction. The data was collected at six month intervals. Importantly, only the primary project sponsor who directly interfaced with the service provider team evaluated the team. If the initial project sponsor was not associated with the project during the survey administration, all the other client managers associated with the project during the time period responded to the survey and their responses were averaged.

Given the nature of the survey, we could collect longitudinal data for each project across multiple time periods. Our overall data comprised compiled surveys related to 182 unique projects – these yielded 822 usable observations. Projects in the dataset had a minimum of two observations each. Ten projects had the maximum number of 10 observations each. The average number of observations per project was 4.51. The surveys were designed to capture perceptual ratings of the constructs discussed in §2 using 5-point Likert scales (1 = strongly disagree, and 5 = strongly agree). Non-response bias was not an issue because feedback was submitted for over 95% of the projects. Further, the examination of multiple projects within a single client-service provider dyad naturally controls for numerous variations that would occur if the observations were spread across companies.

3.2 Scale Validity and Reliability

Given the archival nature of the survey, we rigorously validated the scales used. First, content validation was done by mapping the scales to those used in the software project management literature (see Table 1). Next, we performed a Confirmatory Factor Analysis (CFA) using LISREL 8.72 for the entire set of 822 observations. The RMSEA for the CFA was 0.048, (chi-square (44) = 125.4). The GFI and AGFI were 0.974 and 0.955 respectively.¹ The CFA revealed that the average variance explained (AVE or R-square) for each item was greater than 50% except managing interim goals and quality of delivery. For these items the AVE was 43%.

Second, as a robustness check, we performed a CFA on only the first round of data from the 182 unique projects. The RMSEA for the new dataset was 0.052, chi-square (44) – 66.08. The GFI and AGFI

¹ We also performed an Exploratory Factor Analysis (EFA) with varimax rotation on two random subsets of 300 and 200 observations from the data. In both cases, the overall factor loadings for each of the constructs was above 0.5 and about 77% of the overall variance in each sample was explained.
were 0.94 and 0.90 respectively. Each construct had a Cronbach’s alpha well over the suggested 0.70 threshold (Nunnally 1978) in both the overall sample and unique projects – see Table 1. Further, all t-values in both the CFAs were greater than 10 suggesting good convergent validity.

Third, we tested the constructs for discriminant validity by comparing an unconstrained model with each pair of constructs grouped together and a constrained model with the covariance between the two constructs set to unity (Venkatraman 1989). A significant difference in chi-square between the models indicated that the constructs were distinct. Our tests revealed that each construct was distinct (Table 2). Overall, these findings suggest that the scales are robust.

Finally, given that the service provider collected survey data from a single respondent for each project, one could potentially be concerned about common method bias. We address this issue in § 4.3.1.

3.3 Control variables

First, team size can influence project management abilities and project performance (Kraut and Streeter 1995). We measure size as the total person-months of effort expended on the project (e.g., Kraut and Streeter 1995). This measure accounts for team additions and attrition over time, as well as the total expended effort (Ethiraj et al. 2005). To address team turnover, managers at the studied service provider attempted to cross train employees on multiple tasks. However, team turnover in smaller projects is particularly detrimental because managers have limited flexibility in cross training the limited staff on such teams (Narayanan et al. 2009). Therefore, we introduce team size as a control and also allow for an interaction between team size and team stability (see Appendix for scale items).

Second, we control for: (a) the type of project (M&D versus Testing); and (b) relative project maturity (New versus Mature).

Third, we control for the fraction of total time available to the client manager that he or she expends in interfacing with the service provider’s offshore team (management overhead). During our field work, managers at the offshore service provider suggested that their services reduced the required attention of the client managers on the software management front and freed them up to focus on other important tasks within the client firm – the management overhead variable controls for this effect.
Fourth, we control for the perception of the productivity of the service provider team in relation to their local team based within the customer’s organization. This control is designed to accommodate the effects of any relative productivity comparisons that the client manager may make in evaluating the offshore service provider. Finally, to control for structural changes over time, we include dummy variables to represent the time period during which the data was collected.

4 ANALYSIS AND FINDINGS

4.1 Analysis

Descriptive statistics are in Table 3. We estimated the models in equations (1) and (2) below, in the sequence described in Table 4. The variables outlined in equations (1) and (2) are enumerated in Table 1.

\[ SAT_{it} = \alpha_{10} + \beta_{11}LNSize_{it} + \beta_{12}DT + \beta_{13}NM + \beta_{14}PP_{it} + \beta_{15}PPLAN_{it} + \beta_{16}COMM_{it} + \beta_{17}STAB_{it} + \beta_{18-1,16}TD + \epsilon_{it} \]  

\[ PP_{it} = \alpha_{2} + \beta_{21}LNSize_{it} + \beta_{22}DT + \beta_{23}NM + \beta_{24}PROD + \beta_{25}MGTO + \beta_{26}PPLAN_{it} + \beta_{27}COMM_{it} + \beta_{28}STAB_{it} + \beta_{29}STAB_{it} * COMM_{it} + \beta_{210}PM_{it} * COMM_{it} + \beta_{211}STAB_{it} * PM_{it} + \beta_{212}STAB_{it} * LNSize_{it} + \beta_{2,13-2,2}TD + \phi_{i} + \delta_{it} \]

We used scale averages for each latent variable in equations (1) and (2). To avoid problems with multicollinearity, we grand-mean centered the continuous variables (Kreft et al. 1995). Our model contained both fixed effects (corresponding to the project types and time) and random effects (to capture between-project variability). Therefore, we used a mixed effects estimation approach using the XTMIXED procedure in STATA. This approach also allows us to (a) incorporate repeated project measures; (b) examine higher level random effects related to individual projects nested within project types; and (c) perform likelihood ratio tests that facilitate the comparison of nested models.

We performed other specification checks. First, we treated the projects as nested within project type (primarily M&D and Testing) and examined the variance at the project type level. Further, we checked for the presence of cross random effects between projects and their maturity classification, given that each project matures over time. None of the higher level variances, including the cross random effect

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2 Kreft et al. (1995) note that coefficients of grand-mean centered measures in the hierarchical data when using interaction terms are equivalent to the coefficients of the raw score measures.
parameters, were significant. Finally, we examined alternative estimation methods including Restricted Maximum Likelihood and Maximum Likelihood. Our findings were robust across these methods.

------------------- INSERT TABLES 3 AND 4 HERE -------------------

4.2 Findings

Our estimates are detailed in Table 4. All the antecedent variables have a positive influence on customer satisfaction (Model OS2 – Table 4) – this supports H1. Further, the likelihood ratio test suggests that the model with the antecedent variables is superior to one with only control variables (Likelihood Ratio chi-square (4): 686.21, p <0.01, Model OS2, Table 4). As posited in H2-H4, the direct effects of Project planning (PPLAN), Communication effectiveness (COMM) and Team Stability (TS) positively influence Project performance (PP) (Model PP2, Table 4).

Focusing on the interaction effects posited in H2-H4, the positive effect of communication on project performance is strengthened in the presence of superior project planning capabilities (β=0.160, p<0.01, Model PP3, Table 4) – this validates H2. Next, the positive effect of team stability on project performance is strengthened in the presence of superior project planning (β=0.080, p<0.05, Model PP3, Table 4), i.e., H3 is supported. Further, the positive effect of communication effectiveness on project performance is weakened when team stability is high, supporting H4 (β=(-)0.203, p<0.01, Model PP3, Table 4).

Finally, as an overall test for the interactive influences of the antecedent variables on project performance, we examined the likelihood ratio test comparing models PP2 (which includes only direct effects and no interactions) and PP3 (which also includes all posited interactions) in Table 4. The test suggests that the model PP3 is superior (Likelihood Ratio chi-square (4): 40.66, p<0.01).

4.2.1 Contextual Effects: An exploratory analysis

We employed a two-fold classification of projects: (a) Maintenance and Development (M&D) versus Testing projects and (b) New versus Mature projects. M&D projects focused on new code development, or on improving, rectifying, and modifying software in response to maintenance requests. In contrast, testing projects focused on verification testing and test automation, including the implementation of well defined customer-specified test routines, followed up with a clear reporting of the
test findings. This also involved the development and execution of standard test scripts to automate verification testing. Managers in charge of M&D projects had to cope with the random arrival of requests for new software features and for defect resolutions and enhancements, and with the frequent involvement of the customer. Therefore, M&D projects were characterized by higher uncertainty than testing projects.

The age of the project influences the extent to which the team may generate, institutionalize, and share project-related knowledge. During the initial stages of a project, uncertainty is high because the project scope may not be fully defined and the capabilities of the project team are untested. Such uncertainty typically reduces with time.

The fit between the degree of uncertainty and organizational process characteristics influences organizational performance (Drazin and Van de Ven 1985). Likewise, software project performance may be enhanced when there is a good fit between the level and kind of project risks involved and the deployment of specific risk management practices such as project planning and proactive human resource management (Barki et al. 2001). Accordingly, the impact of project planning, communication effectiveness and team stability on project performance may differ across project types and project maturity. In addition, practices that mitigate risk may also influence customer satisfaction. Accordingly, we examined whether the impact of antecedent variables varied by project type and maturity.

To explore for contextual effects, we introduced interaction terms between the antecedent variables and the corresponding group dummies in equations (1) and (2). To examine whether the impact of project performance varied across groups in equation 2, we additionally included an interaction of the group dummy with project performance. Finally, we performed an overall likelihood ratio test to examine whether the impact of the antecedent variables varied by group (see Table 4, PP4, PP5, OS3 and OS4).

4.2.2 Contextual Effects: Findings

The effects of the antecedent variables on customer satisfaction do not vary across the considered contexts (see Table 4 – Models OS3 and OS4). However, as described below, the effects of the antecedents on project performance do vary across the contexts. Importantly, given that project performance impacts customer satisfaction, this does not rule out the situation where the total impact of the antecedent variables on customer satisfaction – this comprises the sum of the direct and mediated impact via project performance – does vary across contexts. Sobel tests for indirect effects of project
planning (t-value=9.93, p<0.01), communication effectiveness (t-value=3.15, p<0.01) and team stability (t-value=6.17, p<0.01) on customer satisfaction mediated by project performance using models PP2 and OS2 in Table 4 revealed a partial mediation of project performance on overall satisfaction.\footnote{Specifically, we ran an additional regression similar to OS2 without Project Performance variable. In this regression, the coefficients of PPLAN and STAB were significantly higher than in model OS2. The coefficients for COMM were higher but not significant. Overall these provide evidence of partial mediation.} We now summarize our results for the context variables.

**Maintenance & Development [M&D] projects versus Testing projects.** We find that the positive effect of communication effectiveness on project performance is stronger in M&D projects than in testing projects ($\beta=0.206$, p<0.01, Model PP4, Table 4). Effective communication provides the customer with confidence that the project is on track and that the evolving customer specifications and interim project goals are being met. Such communication can more strongly influence project performance and customer satisfaction when uncertainty is high, as is the case in M&D projects.

Second, we find that the impact of project planning on project performance is lower in M&D than in testing projects ($\beta=(-)0.142$, p<0.05, Model PP4, Table 4). This counters arguments in the software engineering literature that the impact of project planning procedures – including task prioritization, work planning, and resource allocation – more strongly impact project performance when project uncertainty is high (Barki et al. 2001). However, our finding is consistent with arguments from organizational theory, where high environmental uncertainty is best managed with less formal planning and stronger liaison mechanisms (Miller 1992; Miller and Friesen 1984). In the presence of external uncertainty, software projects could benefit from practices that support flexibility and responsiveness, rather than practices that pre-commit the project to a rigid plan of schedules and tasks (MacCormack and Verganti 2003; MacCormack et al. 2001).

Finally, we find that the impact of team stability on project performance is higher in testing projects than in M&D projects ($\beta=(-)0.109$, p<0.01, Model PP4, Table 4). Similar to the argument advanced above, flexibility in the team can help manage uncertainty. Further, as Katz and Allen (1982) suggested in their seminal work on R&D management, teams may cut down on communicating with external agencies and become more internally focused when uncertainty is high. In this context, some instability can help team members avoid the Not-Invented-Here (NIH) syndrome.
As seen in Table 4, the likelihood ratio test reveals that the overall impact of the antecedent variables (project management, communication and team stability) on project performance is significantly different across the two classifications, i.e., model PP4 is significantly different than PP3 (Likelihood Ratio chi-square (3): 16.46, p<0.01).

**New versus Mature projects.** Our findings suggest that the effects of the antecedent variables on project performance do not vary by project duration. However, in the context of customer satisfaction (Model OS4 in Table 4), the impact of team stability on satisfaction is stronger ($\beta=(-) 0.094; p<0.1$, Model OS4, Table 4) in mature projects than in new ones. Intuitively, managers we interviewed suggested that, as projects stabilized, teams were often expected to go beyond the basic deliverables in terms of adding value to the customer. For example, a team may proactively initiate a process to improve testing or rewrite software code to ease future maintenance. In addition, as the team engages with a client manager over time, it obtains a better idea of the key drivers of satisfaction that are important to that manager and can also better manage his or her expectations.

As seen in Table 4, likelihood ratio tests suggest that adding the interaction terms (Models OS3 and OS4 in Table 4) to the main model (OS2 – Table 4) does not significantly improve model fit (Likelihood Ratio chi-square (4):OS2 to OS3 = 2.43; OS2 to OS4: 5.34).

### 4.2.3 Control variables

Consistent with our expectations, the customer’s perceptions of the project team’s productivity positively influence perceptions of project performance ($\beta=0.034, p<0.01$, Model PP3, Table 4). Once the main effect variables are introduced, perceptions of management overhead did not have a significant influence on project performance. Finally, the coefficient of the interaction term between team stability and size is negative and significant indicating that, consistent with expectations, team stability has a lesser influence on project performance in larger projects ($\beta=(-)0.04, p<0.05$, Model PP3, Table 4).

### 4.3 Robustness Checks

#### 4.3.1 Common Method Bias

Studies using data from single respondents can invoke concerns about common method variance (CMV). However, as argued below, such bias may not be a major concern in our context.
First, our hypotheses frequently involve interaction effects. Contrary to the belief that CMV uniformly deflates standard errors, recent research indicates it inflates standard errors when interaction terms are studied. As Siemsen et al. (2009, p. 17) note: “A finding of significant quadratic or interaction effects connotes that researchers can be confident that they are not the result of CMV.” Because CMV reduces the likelihood of finding significant effects in an interaction model, this suggests that our findings are robust to any CMV.

Second, longitudinal designs of the type we employ are less vulnerable to CMV than cross sectional ones (Sanchez and Visvesvaran 2002; Rindfleisch et al. 2008; Podaskoff and Organ 1986). Further, on occasions where the team reported to more than one client manager during the time frame of the project that was pertinent to a data collection event, all those managers were surveyed and their response scores were averaged. Of the 822 total observations, 50 involved multiple respondents.

Third, we performed the Harman one-factor test (McFarlin and Sweeney 1992) by comparing a model with all the factors loaded on a single construct versus the hypothesized model. We found that the overall RMSEA increased from 0.048 (chi-square (44) = 125.4) to 0.14 (chi-square (54) = 916.8). This suggests that common method bias may not be a serious issue.

Fourth, CMV is lowered when respondents possess credible and deep knowledge about the responses (Miller and Roth 1994; Phillips 1981). Our survey respondent was the client manager to whom the offshore project team directly reported on the client side. The client manager was actively involved in the project, interacted frequently with the offshore team and was very familiar with the project work content. As such, the client manager was the person who could provide an objective and credible evaluation of the team’s performance.

Fifth, a concern is that positive (or negative) halo effects that the respondent associates with the subject of the study can systematically influence their responses on scale items, thereby leading to CMV. To adjust for such halo effects, we include control variables that account for the total fraction of the respondent’s time that is expended on interfacing with the service provider (management overhead/MGTO), and the respondent’s overall productivity perception of the offshore team (productivity/PROD).

Finally, concerns related to CMV are particularly relevant when survey questions induce social desirability biases. For example, questions related to the respondent’s managerial style or organizational
climate would likely induce such bias. In our case, respondents had little incentive to provide inaccurate responses. If the responses were downward-biased – towards lower performance appraisals – that would discourage the offshore team and ultimately affect work performance. Likewise, if the responses were upward-biased, the client manager could be held responsible for poor team feedback and management if the project work was later judged to be shoddy or inefficiently performed. This would ultimately impact the client manager’s own evaluations within the client organization.

4.3.2 Other Checks

We examined the residuals from our estimated model for outliers. Of the 822 observations we detected on only four error terms that could be considered outliers. Our findings were not sensitive to the removal of the outliers. We also conducted Shapiro-Wilk normality tests to check whether the residuals conformed to a normal distribution. The computed residuals were normally distributed for both the project performance and customer satisfaction models. Next, given that some of our IV’s had high correlations, we examined our analysis for multicollinearity issues. Using OLS techniques on an ex post basis, we examined the variance inflation factors (VIFs) and the condition numbers for each variable using an ordinary least squares approach. The VIFs for each independent variable was below the prescribed limit of 4 (overall mean VIF 2.25) and the condition number (25.19) was below 30 (Cohen et al. 2003). These tests suggest that our estimates are stable. Following that, we checked whether the findings related to new versus mature project classification was sensitive to the time cutoff employed. We employed a two-year cutoff as suggested by Kaka and Sinha (2005) – altering this to a one-year cutoff did not substantially impact the findings.

Given that similar independent variables are included in both equation (1) and equation (2), we used the Breusch-Pagan test to examine whether the errors in equations (1) and (2) were significantly correlated. A significant correlation would imply that running individual regressions may yield biased standard errors. However, the null hypotheses that the correlation is zero was accepted (chi-square (1) = 0.003; p = 0.953) suggesting that individual regressions were appropriate. Finally, to examine whether measures of perceived team stability were correlated with data on real turnover, we sourced turnover data for a sub-sample of about 117 projects (data for the remaining projects were not available). The
correlation between team stability and turnover was -0.288 (p<0.01), suggesting that perceived team stability and actual turnover were significantly related.

4 DISCUSSION AND CONCLUSIONS

Research Implications

We demonstrate the key antecedents in the project management context – project planning, team stability, and effective communication – directly influence project performance and customer satisfaction. Beyond these direct effects, we demonstrate that these antecedents interactively influence project performance. For example, whereas project planning in itself is an important capability, its role in driving project performance is enhanced when it operates in conjunction with effective communication and team stability. From a research perspective, this suggests that attention must be paid to not just establishing the direct effects of capabilities, but also to the notion of configuring a portfolio of capabilities so that their total effect – both direct and interactive – on performance outcomes of interest is maximized.

Further, while the importance of team stability has been discussed in the literature, our study documents the specific impact of team stability on project performance and customer satisfaction in outsourced software projects. We find that team stability positively influences both project management and customer satisfaction, and also interacts with project size, planning capabilities and communication effectiveness in influencing those outcomes. Team stability can compensate for communication frequency and quality in long-term projects because, with a stable team, there is an increased mutual understanding and shared knowledge between the team and the client manager. These findings complement recent research on how team stability supports knowledge management and learning in outsourced software projects (Narayanan et al. 2009), and open up new perspectives for research related to team stability.

From a research perspective, our analysis highlights the role of mediating variables in influencing customer satisfaction. In general, the antecedent variables – project planning, communication effectiveness and team stability – directly affect customer satisfaction and project performance. The interaction effects involving these variables influence project performance, but not customer satisfaction. However, these interactive influences may drive customer satisfaction indirectly through increased project performance. And, as noted earlier, the impact of communication effectiveness on project performance is
muted when team stability is high. From a research perspective, this highlights the importance of careful theorizing to construct pathways of influence that link the variables of interest in study setting similar to ours. A sole focus on direct effects may yield, at best, an incomplete story.

Our findings also reveal an important tension between the need to manage uncertainty through structured approaches such as detailed project planning, and the need to build flexible and agile operations that quickly respond to changes. The planning approach has been highlighted in research that adopts the software risk management perspective (e.g., Barki et al. 2001). In particular, planning is a trait of traditional waterfall model of software development where the emphasis is on an early prediction of challenges and the proactive design of approaches to tackle them. In some contexts, our findings are more consistent with work in organizational theory that emphasizes the role of flexibility and agility in enabling quick responses to rapidly changing market and competitive environments (e.g., MacCormack and Verganti 2003). Such an approach is characteristic of more recent software development methodologies such as agile software development and “scrum” in which collaboration and constant adaptation are emphasized to a greater extent than rigid planning (Highsmith and Cockburn 2001). Future research must be sensitive to these alternative theoretical perspectives.

Finally, our findings reveal that it is important for future research to consider the role of contextual influences.

Managerial Implications

We demonstrate that project planning, team stability, and communication significantly impact project performance and customer satisfaction. This suggests that, while achieving benchmark ratings that reflect technical capabilities (e.g., SEI-CMM) is important for outsourced software service providers, they must also emphasize “softer” skills related to communication, and to managing human resources towards ensuring project team stability. Further, stable teams can also enhance knowledge-sharing and learning (Narayanan et al. 2009). But, managers must implement the appropriate incentives and build a supportive team culture for knowledge-sharing to occur (Siemsen et al. 2007).

Our findings further suggest that managers must pay careful attention to the project characteristics that influence how the antecedent variables impact project performance and customer satisfaction. For example, managers who are focused on highly structured project planning approaches
may benefit from stepping back and demarcating project contexts where such approaches are most useful, as opposed to contexts where flexibility and agility are more relevant. Building flexibility is particularly important in software project settings, which are often characterized by drifting environments caused by changing customer requirements and expectations (Kreiner 1995). However, managers are often not comfortable working with less-structured processes (Olsson 2006). Managers may need to be trained in approaches that allow flexibility, including late locking of requirements, incremental commitment to decisions as evidenced in stage gate models, dynamic resource allocation, and contingency planning.

Finally, managers must broaden their focus from achieving excellence at solely one or a couple of competencies related to project planning, effective communications, and human resource management at the team level. Rather they should view these, and possibly other, competencies as a portfolio of capabilities that must be jointly strengthened. As demonstrated by our findings, the effect of a single competency on the outcomes of importance could depend on the levels of other competencies.

Limitations

Issues related to the cultural fit between the service provider and the client are broadly relevant in the offshore outsourcing context (Kalainagam et al. 2009). Future research that examines multiple service provider-customer dyads can focus on how issues related to cultural fit drive project performance and customer satisfaction, after controlling for other variances across the dyads. Future research can examine the robustness of our findings in other outsourced software service provider contexts using multi-method, multi-respondent data. Some of our measures could also be more robust. For example, we were constrained by the data to use a single item measure of customer satisfaction. Finally, ethnographic and other qualitative studies may provide valuable insights related to the relationships between software service providers and clients that are difficult to obtain through statistically-oriented research approaches.

References


Figure 1: Conceptual framework

Table 1: Scales and reliability measures

<table>
<thead>
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<th>Construct</th>
<th>Overall item Description</th>
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<tr>
<td>Project Planning (PPLAN)</td>
<td>a) Work planning and estimation</td>
<td>Ethiraj et al. (2005)</td>
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</tr>
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<td></td>
<td>b) Managing changes in project schedules/priorities</td>
<td>Wallace et al. (2004)</td>
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<tr>
<td></td>
<td>c) Risk identification and management</td>
<td>Boehm (1989)</td>
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<tr>
<td>Project Performance (PP)</td>
<td>d) Overall Quality of delivery</td>
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<td></td>
<td>e) Overall Timeliness of delivery</td>
<td>Deephouse et al. (1996)</td>
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<td></td>
<td>f) Interim Goals</td>
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<td>Communication Intensity (CI)</td>
<td>g) Quality of status reports</td>
<td>Nidumolu (1995)</td>
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<tr>
<td></td>
<td>h) Timeliness of reports</td>
<td></td>
<td>(0.755)</td>
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<td></td>
<td>j) Written communication ability</td>
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<td>k) Duration of stay of engineers in team</td>
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<td></td>
<td>l) Management of transitions within team</td>
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<td>(0.738)</td>
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Other variables in equations (1) and (2) are as follows: SAT: Overall Satisfaction; COMM: Communication Effectiveness; SIZE: Project Size in person Months; DT: M&D versus testing groups (1 indicates M&D and 0 indicates testing); NM: New versus mature project groups (1 indicates new projects and 0 indicates mature projects); TD: time dummies; MGTO: Management overhead; PROD: Relative productivity perception

† Number in parentheses corresponds to reliabilities computed for the 182 unique projects. The numbers not in parentheses are based on the entire sample size.
Table 2: Difference in chi-square from a constrained model with covariance 1 and free model

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<th>Unconstrained Model</th>
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Table 3: Descriptive statistics

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* p<0.05
### TABLE 4: Regression results for project performance and overall satisfaction

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<td>543</td>
<td>1308</td>
<td>630</td>
<td>635</td>
<td>632</td>
</tr>
<tr>
<td>Residual</td>
<td>0.380***</td>
<td>0.310***</td>
<td>0.303***</td>
<td>0.302***</td>
<td>0.303***</td>
<td>0.463***</td>
<td>0.334***</td>
<td>0.333***</td>
<td>0.332***</td>
</tr>
<tr>
<td>Likelihood Ratio chi-square</td>
<td>467.42***</td>
<td>40.66***</td>
<td>16.46***</td>
<td>0.78</td>
<td>686.21***</td>
<td>2.43</td>
<td>5.34</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1) For the LR test, we compare (a) PP2 with PP1 (b) PP3 with PP2 (c) PP4 and PP5 with PP3 (d) OS2 with OS1 (e) OS3 and OS4 with OS2; (3) *p <0.1 **p <0.05 ***p <0.01; (4) N=822 (5) In addition to the variables shown in the table, nine dummy variables were added for both project performance and overall satisfaction equations to account for common effects of the time period in which the data was collected (6) N/A indicates that the variables were not applicable in the regression.
APPENDIX – LIST OF ITEMS

Agreement to the following questions were rated on a five point scale from 1 (very low) to 5 (very high) with respect to the offshore service provider team

PROJECT PLANNING (PPLAN)
Your team planned and estimated their work well
Your team managed changes in priorities and schedules well
Your team identified and assessed project risks early and adopted workarounds to meet the project goals

PROJECT PERFORMANCE (PP)
You are satisfied with the quality of the deliverables of your team.
You are satisfied with the timeliness of the deliverables of your team.
Your team proactively meets interim expectations of the project

COMMUNICATION EFFECTIVENESS (COMM)
Your team has consistently provided the status reports you need to manage your work.
Your team communicates frequently with you through the use of emails, conference calls etc
The ability of your team to communicate clearly through oral means is high
The ability of your team to communicate clearly through writing is high

TEAM STABILITY (TS)
You are satisfied with how long engineers remain on your team.
When an engineer leaves your team, you are satisfied with how the transition is managed.

PRODUCTIVITY PERCEPTIONS (PROD)
Compared to your local engineering team the productivity of the service provider team is:
Equal to Local team
90 - 99% of Local Team
80 - 89% of Local Team
70 - 79% of Local Team
Less than 70% of Local Team

MANAGEMENT OVERHEAD (MGTO)
What percentage of your time is spent in managing the service provider team?
< 10%
10% to 20%
20% to 30%
30% to 40%
40% to 50%
>50%

OVERALL SATISFACTION (SAT)
How would you rate your overall satisfaction in using the team?