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Systems Development Ambidexterity:  
Explaining the Complementary and Substitutive Roles of Formal and Informal Controls

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Abstract

Although formal and informal control mechanisms are often simultaneously used to govern systems development projects, considerable disagreement exists about whether the use of one strengthens or diminishes the benefits of the other. In other words, are they complements or substitutes? Competing theoretical perspectives favor both sides of the argument, and neither the IS controls literature nor the IS outsourcing literature has addressed this issue.

In this study, we theoretically develop the idea that these competing perspectives are mutually compatible rather than contradictory because informal and formal control mechanisms can simultaneously be complements *and* substitutes. Using data from 120 outsourced systems development projects, we show that informal control mechanisms strengthen the influence of formal behavior control mechanisms on systems development ambidexterity (complementary effects) but weaken the influence of formal outcome control mechanisms (substitutive effects).

Our key contribution therefore lies in exploring interactions among control mechanisms in a project's control portfolio to reconcile the competing theoretical perspectives on whether formal and informal controls are complements or substitutes. Our findings provide managers guidance on how to carefully combine formal and informal control mechanisms in a project. Combining informal with formal process-based control mechanisms can simultaneously enhance the fulfillment of project goals and development flexibility. However, combining informal with formal outcome-based control mechanisms can instead impair these objectives.

**Keywords:** Outsourcing, signaling, software project control, project governance, ambidexterity, control mechanisms, signaling, systems development, interaction effects.

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## INTRODUCTION

Organizations that outsource systems development often use a variety of formal and informal control mechanisms to align vendors' interests with their own. Such mechanisms are intended to ensure that systems development progresses along a project plan that leads to the fulfillment of the client's project objectives. In short, control mechanisms are intended to enhance alignment in outsourced systems development. However, changing user needs, evolving client priorities, and competitive pressures can introduce new requirements in the midst of development [51, 68, 90]. Accommodating them requires flexibility in the systems development process, which can be at odds with the intent of control—adherence to a predefined project plan [90]. The need for such flexibility is strongly emphasized by proponents of agile software development methods [42]. In other words, systems development projects must simultaneously exhibit alignment with client needs and adaptiveness to evolving client requirements. This ability to be simultaneously aligned and adaptive is what Gibson and Birkinshaw [30] call ambidexterity.

Clients, under a “more control is better” presumption, often hedge their bets by simultaneously using formal and informal control mechanisms to govern outsourced systems development. Although the absence of previously-asserted links between control and systems development performance found in Tiwana and Keil's [90] recent study brings this assertion into question, it also raises an important but neglected question about the consequences of combining formal and informal control mechanisms *within* the same project control portfolio. In other words, do formal control mechanisms amplify or attenuate the benefit of simultaneously using

informal control mechanisms? Or, more broadly, are formal and informal control mechanisms complements or substitutes?

The simple but powerful notion of complements and substitutes formally originated in economics [60], and has been widely invoked for theory development in prior IS [9, 86] and management literature [4, 82, 94]. Two things are complements if more of one increases the benefits of using the other. They are substitutes if more of one diminishes the benefits of using the other. In our context, if formal and informal control mechanisms are complements, then using more of one should increase the benefits of using more of the other. If they are substitutes, then using more of one should decrease the benefits of using more of the other.

This issue of how formal and informal control mechanisms interact within a single project (“portfolio-level interactions”) remains neglected, despite the simultaneous prevalence of both. Neither the IS controls literature (focused primarily on explaining the choice of control mechanisms [16, 46, 62, 80] and to a lesser extent their impact on performance [40, 90]) nor the IT outsourcing literature (focused on outsourcing decisions and the impact of interfirm processes [49, 53, 84, 88]) has attempted to address this question. This is problematic in practice because when managers use both formal and informal control mechanisms without understanding how they interact, they will diminish each other’s benefits if they act as substitutes.

The question about whether informal control mechanisms strengthen or weaken the benefits of formal control mechanisms is muddied further by two theoretical perspectives in prior research that take opposing positions. Transaction cost economics (TCE) and relational governance perspectives view formal and informal controls as substitutes, an assertion that subsequent empirical tests have failed to support. The controls literature also implicitly takes the substitutes position by emphasizing that formal and informal controls are appropriate under

different circumstances [23, 65]. A competing interfirm adaptation perspective takes the opposite position that asserts complementarities and suggests that they are “not simply substitutes” [14].

These contradicting positions have led Anderson and Dekker [1] to surmise that the complementarities and substitution effects among different forms of control remain theoretically underdeveloped. We address this research gap, guided by the following research question:

Do informal control mechanisms increase (complement) or decrease (substitute) the benefits of formal control mechanisms in enhancing systems development ambidexterity in outsourced projects?

We begin by emphasizing that appreciating the nuanced, multiple roles of formal and informal control mechanisms requires thinking of performance in terms of systems development ambidexterity. Systems development ambidexterity, which conceptually builds on Gibson and Birkinshaw’s [30] notion of ambidexterity, refers to the capacity to *simultaneously* exhibit alignment with the client’s needs and adaptiveness to changes in those needs in systems development activities. The key here is that both alignment and adaptiveness must be simultaneously achieved for the systems development process to be characterized as ambidextrous. We emphasize that the notion of systems development ambidexterity is a useful complement to—not a replacement for—the classical efficiency and effectiveness measures of systems development performance. (We subsequently show that greater ambidexterity enhances both systems development efficiency and effectiveness.)

We then develop the idea that formal and informal control mechanisms simultaneously act as complements *and* substitutes. By complements, we mean that the simultaneous use of an informal control mechanism strengthens the benefits of a formal control mechanism; by substitutes we mean that the simultaneous use of informal control weakens the benefits of a formal control mechanism. We explain how informal control mechanisms will complement a

specific type of formal control mechanisms when it facilitates acquiring *reliable* information needed to enforce that type of formal control.

Tests using data from 120 outsourced projects demonstrate that while informal control mechanisms complement formal behavior control mechanisms, they have a substitutive relationship with formal outcome control mechanisms. Thus, we show that the competing complementarities and substitution perspectives among formal and informal control mechanisms are mutually compatible, not contradictory. The theoretical reconciliation of the complementarities and substitution between formal and informal control mechanisms therefore forms our central contribution.

The remainder of the manuscript proceeds as follows. We first review the competing theoretical perspectives in prior research, isolate the theoretical root of this contradiction, and develop hypotheses that reconcile these competing views by proposing that formal and informal control mechanisms are both complements and substitutes. We then describe the methodology, analyses, and the research implications and contributions of our findings.

## **THEORY AND HYPOTHESIS DEVELOPMENT**

### **Control in Outsourced Systems Development Projects**

Control refers to how the actions by the vendor are governed in a manner that furthers the interests of the client [16].<sup>1</sup> Control over the vendor (the controllee) is implemented by the client (the controller) through a variety of concurrently-used formal and informal control mechanisms that collectively constitute a project's control portfolio. Formal control mechanisms can take two forms: (a) outcome control, which refers to the prespecification by the client of desired final and

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<sup>1</sup> Control in this study refers to control by a principal over an agent in the agency theory perspective along the lines of Ouchi's control theory [65], rather than an unrelated systems dynamics and engineering notion of control within complex systems [see 79].

intermediate vendor outputs without regard how they are achieved and (2) behavior control, which refers to the client explicitly prescribing methods, procedures, and techniques to the vendor for accomplishing project activities [64]. The key form of informal control is clan (or social) control, which refers to control through the promulgation of common values, beliefs, and shared goals between the client and vendor, and by identifying and reinforcing norms of acceptable behavior [16, 65]. Therefore, clan control relies on the values and beliefs shared by the client and vendor to align their interests and objectives in the context of a project. Formal control mechanisms therefore rely on information and informal control mechanisms rely on a system of shared norms, values, and goals that encourage desirable behaviors.

Although the IS literature explicitly recognizes vendor-driven self control as another informal control mechanism [48], we did not include it in this study for three reasons. First, since it is vendor-driven rather than client-driven like other control mechanisms, it is analogous to non-control [16, 17]. Second, it is less widely recognized in the broader controls literature, especially in interfirm settings [67, 91]. Third, a recent study by Choudhury and Sabherwal [16] has found it to be conspicuously absent in outsourced IT projects (this study's context). Recent empirical work has also confirmed that it is likely to be used to a much greater degree in internal projects than in outsourced projects [90]. We therefore focus on the more broadly accepted form of informal control i.e., clan control.

### **A Summary of Contradictory Theoretical Perspectives in Prior Research**

Prior theory and empirical research disagrees about whether formal control mechanisms complement, substitute, or operate independently of informal control mechanisms within a control portfolio. Proponents of two competing theoretical perspectives favor opposite types of control strategies and agree that their preferred choice leaves little room for the other. For

example, the TCE perspective advocates formal control, emphasizing that explicit contractual safeguards are necessary to align the divergent objectives of clients and vendors in interfirm outsourcing [1, 93, 95]. In contrast, the relational governance perspective—grounded in socio-psychology—advocates trust-based informal control mechanisms as a less costly, self-enforcing alternative to formal control mechanisms [21, 33, 36, 59, 92]. Proponents of this perspective argue that informal controls constrain opportunism while offering greater flexibility and lower implementation costs vis-à-vis formal control mechanisms. Therefore, both TCE and relational governance perspectives view formal and informal control mechanisms as substitutes—an assertion that subsequent empirical tests have failed to confirm (e.g., [43]). Such substitution is also implicitly asserted in the organizational controls literature, where formal and informal control mechanisms are deemed appropriate under different circumstances [23, 65].

Paradoxically, the limited empirical research on this issue contradicts the substitution argument [56, 61, 74]. In a thought-provoking synthesis of these perspectives, Poppo and Zenger [74] empirically demonstrate that contract-driven formal controls *complement* informal controls, contrary to the frequent assertion of TCE and relational contracting theorists. (It should be noted that they arrived at this conclusion by testing the relationship between the two mechanisms rather than the effect of their interaction term on performance.) They argue that formal and informal relational control mechanisms overcome each other's inherent limitations, promote cooperation while protecting both parties, in turn amplifying their mutual benefits. This perspective is consistent with the implicit assertion in the IS project control literature that formal and informal control mechanisms serve different roles [16, 48]. More recently, Das and Teng [17] have observed that formal control and trust-based control are not linked by a “strictly complementary relationship,” suggesting that their relationship might be more complex than previously assumed.

Recent empirical work similarly suggests that formal and informal control mechanisms are “not simply substitutes” because each has specific advantages and disadvantages [14]. However, the theoretical details of such relative merits remain neglected, leading Anderson and Dekker [1] to surmise that the complementarities and substitution effects among different forms of control remain theoretically underdeveloped. These bodies of work have not directly addressed portfolio-level interactions, where both formal and informal control mechanisms are simultaneously used in a project’s control portfolio.

We contend that such apparent contradictions in the literature arise from three sources. First, empirical work on the complements-substitutes issue has rarely distinguished—perhaps unwittingly—between different *types* of formal control i.e., control that is based on evaluating outputs on predetermined criteria (outcome control) versus control over the processes through which a vendor achieves them (behavior control). As Das and Teng [17] lament, the diverse formulations of control have led scholars to simultaneously refer to an organizational setup, a process of regulating behaviors, and an outcome. For example, several empirical studies have combined outcome and behavior control into a unidimensional conceptualization of formal, contract-based control [56, 61, 74]. This is surprising since the IS project control literature has long distinguished among different forms of control, both theoretically and empirically [16, 46].

Second, prior work has viewed trust and cooperation as being isomorphic with informal control (e.g., [12, 56, 74]). However, trust itself is not a control mechanism [17]; a client can trust the vendor yet not rely on informal control mechanisms to govern a particular project.

Finally, while the broader alliances literature recognizes the simultaneous need for alignment of partners’ activities and the need for interfirm adaptation, it has implicitly treated them as trade-offs rather than a necessary tension. Therefore, the substitutes (e.g., TCE and

relational contracting) and the complements perspectives invoke—without directly incorporating—the alignment-adaptiveness tensions associated with formal and informal control mechanisms.

Recognizing their simultaneity—or shifting from an either/or view to a both/and perspective [85]—can potentially yield new insights. Conceptualizing performance in a manner that considers alignment and adaptation metrics simultaneously would therefore be more consistent with both the IS project control and broader interfirm control literatures, which have invoked both the need for client-vendor alignment and adaptation during the development process. This underappreciated dual role of control mechanisms is discussed next.

### **Recognizing the Dual Role of Control Mechanisms in Systems Development**

The role of controls in facilitating alignment of vendor activities with client objectives is explicitly recognized but their role in facilitating adaptation in systems development projects is pervasive but implicit in prior research. For example, Henderson and Lee [40] have shown that formal controls are associated with project efficiency and effectiveness. Similarly, Tiwana and Keil [90] have recently shown how different controls differ in their impact on performance in internal and outsourced projects. However, besides alignment, both the interfirm governance literature [16, 17, 44, 50], and the TCE and relational contracting perspectives (e.g., [52, 95]) implicitly recognize the need for adaptiveness to correct misalignments with evolving client imperatives. While this simultaneous need for alignment and adaptation is pervasive in theorizing about interfirm control mechanisms [56], almost no empirical studies have directly and simultaneously assessed both facets. Similarly, the requirements analysis literature has also emphasized the need for software projects to meet requirements that are representative of actual user needs [58], which themselves might evolve over the course of systems development.

Inattention to flexibility in the systems development process is also an explicitly recognized theoretical gap in the IS controls literature [90]. Systems development ambidexterity is therefore a theoretically useful representation of software development performance, which we subsequently also demonstrate as being associated with classical efficiency and effectiveness measures of performance.

We define *systems development ambidexterity*, following Gibson and Birkinshaw [30], as the capacity to simultaneously exhibit alignment and adaptiveness in project activities. *Alignment* is defined as the degree to which the work of the vendor fulfils the project objectives (e.g., the client’s requirements, outsourcing objectives, and quality expectations). *Adaptiveness* is defined as the degree to which the vendor is able to rapidly reconfigure its project activities to correct misalignments with evolving project objectives. The need for such adaptiveness can arise from changes in the needs of the client, refinement of project requirements, and technological or environmental changes.

Systems development ambidexterity is therefore a multidimensional construct, with alignment and adaptiveness constituting “separate, but interrelated, nonsubstitutable” elements [30]. In other words, greater alignment cannot substitute for lack of adaptiveness or vice versa. Recent intrafirm empirical studies have shown—and we confirm in an interfirm outsourcing context—that ambidexterity is an important predictor of traditional measures of performance (e.g., meeting cost, schedule, and performance targets) [30, 39]. Our conceptualization of outsourcing performance in terms of systems development ambidexterity aligns well with the spirit of Sundramurthy and Lewis’ [85] recommendation for adopting a “both/and” rather than an “either/or” perspective for managing governance paradoxes by recognizing the simultaneous need for alignment and adaptiveness. This perspective therefore emphasizes creating a context in

which alignment and adaptiveness can simultaneously flourish. It also faithfully captures the underlying intent of interfirm control i.e., the actual attainment of partnership goals [14, 17, 21, 44].

To be effective, the deployed formal control mechanisms must be effectively enforced [16, 89, 90]. For formal control mechanisms to be effective sanctioning devices, deviations from the prespecified goals and prescribed processes must be *accurately verifiable* [14, 66]. As Das and Teng [17] caution, organizations do not achieve effective control simply by implementing control mechanisms. Drawing on the recent theoretical distinction between attempted and realized control introduced by Tiwana and Keil [90], it is not the extent to which control is attempted but rather the extent to which it is realized that impacts systems development outcomes. (They define attempted control as the degree to which a controller implements a specific control mechanism in an attempt to influence controllee behavior and realized control as the degree to which the controller is able to successfully exercise it during the systems development process.) Enforcing/ realizing both forms of formal control—which are information based [23, 65, 90]—requires *different types* of information to evaluate the vendor’s compliance with the criteria set by the outcome and behavior control mechanisms. In this study, we refer to such information required for enforcing either type of formal control as the “evaluation information” associated with it. Tiwana and Keil [90], building on Ouchi’s work, refer to this as the informational requirements for realizing any form of attempted formal control. Carson et al. [14] describe the difficulty of reliably acquiring such evaluation information as the “metering” problem, which remains largely neglected in the literature [18]. Formal control can therefore be viewed as control through information; the client interprets evaluation information to appraise the vendor’s accomplishment of the prespecified goals (for outcome controls) or compliance

with the prescribed methods and procedures (for behavior controls) and then imposes the corresponding penalties/ rewards. Informal control mechanisms, unlike formal control mechanisms, rely on social underpinnings (e.g., client-vendor trust, and shared values and beliefs) rather than information [65].

### **Conceptual Underpinnings of Complementarities and Substitution**

The notion of complements and substitutes formally originated in economics [60], and has been widely invoked for theory development in prior IS [9, 86] and management studies [4, 82, 94]. Complementarities exist between two things when doing more of one thing increases the returns from doing more of another [60]. Substitution effects exist when doing more of one thing decreases the returns from doing more of another [60]. From a statistical testing standpoint, complements are characterized by a positive interaction effect and represent the conceptual opposite of substitutes, which are characterized by a negative interaction effect [74, 82]. In the context of our study, a significant positive interaction effect between informal control and a given type of formal control would suggest that they are complements and a negative one would suggest that they are substitutes.

From a theory development perspective, complementarities and substitution effects between formal and informal (clan) control mechanisms can be predicted by considering the effect of clan control mechanisms on the cost of acquiring information needed to enforce either type of formal control. Informal control mechanisms, logically, can increase, decrease, or simply have no effect on acquiring reliable evaluation information for a specific type of formal control mechanism. The central thesis of our theory development is the following: Clan controls will complement a specific type of formal control when they facilitate acquiring *reliable* evaluation information needed to enforce that type of formal control. The two types of formal control have

different informational requirements for enforcing them and therefore interact with informal control in different ways. Table 1 summarizes the forthcoming theoretical logic for the interactions of informal clan control with the two forms of formal control. This logic, which expands the notion of information requirements of formal control in [90], is developed in detail separately for both outcome and behavior control mechanisms next.

<< INSERT TABLE 1 HERE >>

### **Outcome Control and Clan Control as Substitutes**

Outcome control mechanisms prespecify what the vendor should accomplish in a project. They establish the evaluation criteria by which the outputs of the vendor will be judged (e.g., milestones, delivery time tables, and budgets). This establishes accountability for the vendor's intermediate outputs (deliverables at predetermined milestones) and final outputs (e.g., budget, deadlines, and quality of the finished system). Enforcing outcome controls requires evaluation of information about vendor outputs i.e., judging whether the vendor outputs meet the prespecified goals (e.g., satisfying project requirements, budget, and deadlines). The evaluation information that is required to enforce outcome controls is reflected directly in the intermediate and final work delivered to the client by the vendor [90]. In other words, the evaluation information is directly discernible from vendor outputs. Examples include timeliness and cost compliance of the key deliverables. Since such evaluation criteria are clearly established at the outset, the vendor has limited discretion in interpreting or adjusting them. Such ex ante, objective metrics can by themselves induce the vendor to behave in ways that increase compliance with those metrics, which are the same ones that increase fit with the project's objectives. Furthermore, assuming that the client set the appropriate targets for the vendor, outcome control mechanisms create a strong extrinsic incentive and goal orientation that motivates the vendor to rapidly

correct any misalignments with the client's needs. This reasoning is consistent with Kirsch and her colleagues' [46, 47] findings that greater outcome measurability is associated with greater use of outcome control mechanisms. In summary, the evaluation information needed to enforce outcome controls can objectively and reliably be acquired by the client directly from the vendor's outputs, without having to rely on clan control and independent of the degree to which clan control is used.

Although outcome control does not depend on clan control for acquiring reliable evaluation information needed to enforce it, the presence of outcome control can create a context that can be less conducive to clan control. The alliances literature has observed that the use of outcome control mechanisms can be perceived as a signal that vendor is not deemed trustworthy enough to behave appropriately without such controls [17, 85]. Such negative signaling might be unintentional on the client's part since performance clauses are standard practice in outsourcing contracts, and intended to safeguard against opportunism. Nevertheless, a client's attempt to use clan control mechanisms under such conditions can send conflicting signals to the vendor, slowing the vendor's judgments about acceptable responses to new information, and overall impeding adaptation during the development process. Their mere use can blunt the value of social ties and impede the development of trust, undermining the effectiveness of clan control mechanisms [44]. It also raises the apprehension that some cooperative, well-intentioned acts of the vendor might incorrectly be sanctioned by the client as opportunistic, reducing vendor incentives to contribute beyond the scope of preexisting contractual stipulations [14]. The presence of detailed formal contracts can even exacerbate vendor opportunism in actions that are not explicitly covered by the formal contract [11]. Outcome control mechanisms can therefore undermine the client's capacity to employ informal governance devices such as clan control [29].

Recall that the client's acquisition of reliable evaluation information needed to enforce outcome controls does not rely on the conditions associated with clan control. Such information can be objectively assessed from the cost and schedule compliance of the completed project deliverables. Even with minimal trust, a client can have sufficient confidence if adequate and usable performance metrics are in place [17]. Kirsch et al. [47] provide some implicit support for this logic in showing a positive association between the ability to measure outputs in systems development projects and greater use of outcome control mechanisms. Clan control mechanisms are therefore likely to be ineffective—even counter productive—in the presence of outcome controls. In summary, outcome control mechanisms do not need nor depend on clan control, and their mere presence can create conditions that can be nonconductive to clan control. We therefore expect a negative interaction (i.e., substitution) effect of outcome and clan control mechanisms on systems development ambidexterity.

***Hypothesis 1:** Greater use of clan control mechanisms weakens the extent to which outcome control mechanisms enhance systems development ambidexterity.*

### **Behavior Control and Clan Control as Complements**

Behavior control mechanisms specify how the vendor should accomplish the project objectives i.e., they define a set of rules, methods, and procedures that the client expects the vendor to follow [65]. Enforcing behavior controls requires evaluation of vendor behavior i.e., how well the vendor, during the development process, adhered to the methods and procedures prescribed by the client. The evaluation information requirements for enforcing behavior control therefore differ from those of outcome control in one important way—it depends on information about the vendor's adherence to the methods and procedures prescribed by the client.

In internal projects, greater behavior observability is therefore associated with greater use of behavior control mechanisms [46, 90]. Since the client and vendor represent two distinct

organizations in outsourced projects, there are usually no preexisting reporting relationships or natural conduits for acquiring such evaluation information or for readily observing vendor behavior [16, 90]. Therefore, evaluation information is typically obtained through direct monitoring and vendor self-reports (e.g., weekly progress reports, periodic meeting, conference calls, and ongoing documentation of work processes) [16]. Since the sanctioning mechanisms of behavior control rely heavily on monitoring vendor behavior [64], their effectiveness is tied directly to the reliability of such evaluation information. Unlike outcome controls, such evaluation information is not directly discernible from vendor outputs and depends at least to some extent on vendor self reporting. Specification of behavior control mechanisms, by itself, cannot guarantee the reliability, integrity, and timeliness of the pertinent evaluation information from the vendor.

This is usually problematic in outsourced systems development because the weaker formal authority and organizational separation make it difficult for the client to cost effectively monitor the vendor's compliance with the prescribed methods and procedures [16, 19, 76, 89]. Low observability due to geographical dispersion, coordination overhead, and loss of communication richness can further exacerbate such monitoring challenges [90]. Furthermore, the mere use of behavior control—like for outcome control—can signal that the client does not trust the vendor's ability to accomplish the systems development activities without its guidance. Therefore, behavior control can also have a negative signaling effect about the vendor's perceived competence without readily providing the conditions conducive to honest information sharing necessary to enforce it. The vendor might therefore withhold critical information from the client, particularly about noncompliance with prescribed methods and procedures, due to apprehension of reprisal.

Since it is almost impossible to monitor every detail of vendor activities [17], the client relies to a large degree on the accurate self reporting of evaluation information by the vendor. Agency theory would suggest that such self reporting would increase the likelihood that the vendor (the agent) will act in ways that fit its own best interests, even if they conflict with the client's interests [7]. For example, the vendor might selectively communicate, conceal, or manipulate information that makes the vendor look bad in terms of the process control system [75, 98]. The difficulty of verification by the client lowers the risk of the vendor being caught engaging in such opportunism, which can encourage vendor employees to present inaccurate or invalid data about the completed processes or withhold relevant information that conflicts with scoring well on the behavior control system [34, 75].

Clan control, when used in conjunction with behavior control, provides an environment that is more conducive to acquiring reliable evaluation information that is needed to make behavior control work more effectively. Clan control mechanisms can enhance the reliability of the evaluation information that the client acquires from the vendor for enforcing behavior controls for two reasons. First, confidence in vendor cooperation is essential for effective behavior control but is by no means automatic [17]. Since trust is a basic social prerequisite for clan control, the deployment of clan control mechanisms signals that the client has confidence in and trusts the vendor to some degree [5, 31, 65]. This signals that the client holds a positive attitude towards the goodwill and reliability of the vendor [17]. This can mitigate or counteract some of the perceived negative signaling by the imposition of behavior controls. When the vendor realizes that the client has given the vendor considerable benefit of doubt in trusting them, the vendor is more likely to be motivated to act in a cooperative manner [11, 17]. This creates conditions conducive to honest and open information sharing by the vendor [21, 44],

which increases the likelihood that the client will receive accurate and reliable evaluation information pertaining to behavior controls. The presence of trust signaled by clan control mechanisms also encourages the firms to openly discuss and mutually agree upon any procedural adaptations and refinements that might become apparent after project activities have begun. It also lowers the need for the client to attempt to constantly verify information reported by the vendor, which can otherwise impede interfirm adaptation. In that sense, clan control fosters bilateralism [74].

Second, interfirm interaction during the process of exchanging behavior control evaluation information can foster social relations and strengthen the socialized acceptance of shared values and beliefs, in turn developing conditions that are more conducive to effective clan control [16]. This can reinforce vendor employees' beliefs that they are playing an integral role in collective goal achievement, mitigate some of the potential untrustworthiness-signaling effects of behavior control, and make the vendor less hostile towards the behavior control system [75]. Overall, this will increase their sense of ownership and commitment to following the prescribed methods and procedures. Thus, the use of clan control mechanisms in conjunction with behavior control mechanisms can lessen the tendency of the process control system to induce manipulative and dishonest behaviors. Therefore, greater use of clan control mechanisms enhances the effect of behavior control mechanisms on systems development ambidexterity, and vice versa. We therefore expect a positive interaction effect (i.e., complementarity) of behavior control mechanisms and clan control mechanisms on systems development ambidexterity.

***Hypothesis 2: Greater use of clan control mechanisms strengthens the extent to which behavior control mechanisms enhance systems development ambidexterity.***

## METHODOLOGY

### Data Collection

The hypotheses were tested using data collected through a field study of 120 outsourced IT application development projects in 120 firms conducted in 2006 in which a vendor developed a custom software application to solve an idiosyncratic client business problem. Such arrangements are widely used to access specialized technical capabilities in software development, where both formal and informal governance strategies are common. Further, they are characterized by high asset specificity because the software application is custom developed to meet the idiosyncratic needs of a particular client. We attempted to collect data from two informants: (1) the lead project manager in the vendor firm and (2) a client firm manager responsible for the project, complemented by archival secondary data. The objective was to increase the robustness of the findings and to mitigate the threat of common methods bias.

Our sample was drawn from the entire membership base of the National Association of Software Services Companies, the consortium of Indian IT services firms with a significant US clientele. We approached the CEO/ President of all 719 member firms that specifically listed software services outsourcing as their specialty to identify the lead project manager for a project outsourced by a US company. Of these, 69 firms declined to participate for a variety of reasons (e.g., no US clients, changes in business model, or unwillingness to participate) and an additional 23 firms were unreachable. Of the remaining 627 firms, 120 responded (19.1% response rate). Following this phase, we requested dependent variable assessments from the client-side manager for these 120 projects. 19 of these requests were refused. 30 responses were obtained for a 29.7% (30/101) response rate. The sole purpose of collecting these matched responses was to assess common methods bias, as described later. The client firms represented a diverse variety of

industries including financial services (18%), manufacturing (15%), retail (5%), and other industries. All vendor firms specialized in custom software development, so objective data for all firm-level control variables were collected from the Indian consortium's records. The consistent use of Indian vendors and US clients in the sample mitigates the potential confounding effects of other variables (e.g., sociocultural distance) that are not included in the model.

We followed Armstrong and Overton's [2] procedure of comparing the early (first 25%) and late (last 25%) respondents on all key independent variables to evaluate the threat of nonresponse bias. T-tests on all independent variables (outcome control,  $T = .070$ ; behavior control,  $T = -.343$ ; clan control,  $T = .524$ , all nonsignificant) and project characteristics (such as project duration, team size, project scope, client-vendor history, contract structure type, multinational vendor origin) comparing the early (first 30) and late (last 30) respondents showed no significant differences, providing assurance against nonresponse bias. Even though this analysis revealed no significant differences, caution is warranted since we were not able to directly compare data from respondents and non-respondents.

### **Construct Measures**

Existing scales were adapted to the study's context (the items appear in the Appendix). The scales for the principal theoretical constructs in the study were multi-item, 7-point Likert scales operationalized at the unit of analysis of the theoretical model, which was the outsourced project. We focused on the outsourced project as the unit of analysis, recognizing that the governance structure used in a specific project does not necessarily mirror the broader interfirm governance structure [28]. Several control variables were based on objective, archival records. Gibson and Birkinshaw's [30] approach was adopted for measuring systems development ambidexterity as the multiplicative term of alignment and adaptiveness, which they characterize as the two

interrelated, nonsubstitutable dimensions of ambidexterity (which they examined at the organizational unit level rather than the project level). Alignment was measured using four items adapted from Faraj and Sproull [25] to assess the extent to which the outsourced project development process was effective in successfully fulfilling the client's project needs, quality expectations, functional requirements, and project objectives. Adaptiveness was measured using four items to assess the extent to which it was possible to incorporate new requirements and design changes in response to changing client needs during each of the major project stages—requirements analysis, high-level design, detailed design, development and coding [97]. Kirsch et al.'s [47] scales for outcome, behavior, and clan control were used with minor adaptations. The control variables and their sources are described in the subsequent section. The construct measures exhibited discriminant validity verified through exploratory factor analysis of all items for all independent and dependent variables in the model as shown in the Appendix. One item from Kirsch et al.'s scale for outcome control (client's emphasis on meeting project requirements) was deleted in the scale purification process due to high cross-loadings. The remaining items (including one item that loaded slightly below Nunally's [63] recommended threshold of 0.6) have been used in several prior studies in the work of Kirsch and her colleagues and were retained to maintain the theoretical coverage of their original measure. As the Appendix shows, the pattern of item to construct loadings and cross-loadings is acceptable, and the extracted factors had Eigenvalues  $\geq 1$ . The measures also had adequate reliability, which is indicated by scale alphas ranging from .63 to .9. Construct correlations, means, standard deviations, and alphas are summarized in Table 2.

<< INSERT TABLE 2 HERE >>

## **Control Variables**

Control variables of four different types were included in the model to account for alternative explanations. These four types included: (a) partnership characteristics (client-vendor ties, client-vendor collaborative history, project scope, duration, contract structure, and the knowledge that the two firms had of the other's domain), (b) project characteristics (such as software platform), (c) firm effects (vendor capability maturity level, age, scale, and national origin), and (d) industry effects that can potentially explain systems development ambidexterity independent of our model. These were used to rule out four overarching types of rival explanations for systems development ambidexterity independent of the formal and informal control mechanisms in our model.

Partnership characteristics were used to rule out the rival explanation that clients and vendors with close ties, a longstanding history, greater knowledge of each other's domains, and with time-and-material contracts (as opposed to fixed price contracts) are more likely to exhibit greater project ambidexterity independent of the formal and informal control mechanisms that our model focuses on. Project characteristics were included to account for the possibility that certain project characteristics such as project scope, length, and software platform could explain ambidexterity in systems development independent of the explanatory variables in our model. Similarly, firm effects account for other plausible rival explanations that vendors might exhibit greater systems development ambidexterity because of greater capability maturity, greater scale of operations, veteran presence in the software industry, and multinational backgrounds rather than the key explanatory variables in our model. Finally, whether the client is in the services, retail, or manufacturing industry could also account for differences in systems development

ambidexterity. We next discuss in detail each of the thirteen control variables in each of these four broad types of rival explanations.

Close client-vendor ties are conducive to higher performance [13, 70]; we therefore controlled for *client-vendor ties*. We adapted Hansen's [38] three item scale to assess the extent to which the overall working relationship between the client and vendor were characterized by regular interactions, frequent communication, and close working relationships. Similarly, a client and vendor with a history of collaboration are likely to better align project activities; we therefore included a dummy variable for interfirm *relationship history* [69]. We also controlled for *project scope* because projects with atypically larger scope (e.g., greater size, complexity, or person-months of development effort) can lower vendor effectiveness [3, 78, 96]. This roughly corresponds to the notion of project complexity in the "dynamic model of requirements analysis" [58]. We used three items adapted from Barki et al. [8] to assess the project relative to others previously completed by the vendor on person-months of development work, project duration, and dollar budget (anchors: much smaller—much larger). Effective software outsourcing requires the client to clearly and precisely communicate project requirements to the vendor at the outset of the project [20, 35, 41, 54, 72]; we therefore controlled for *project goal codifiability*. This roughly corresponds to the outcome measurability construct in the IS project control literature [47]. We used three items adapted from Hansen [38] that assessed the extent to which the client's project requirements could easily be documented, explained to the vendor firm in writing, and communicated formally (e.g., via documents, requirements, code comments, and manuals). In addition, we included a control for *project duration* (measured in months), recognizing that longer projects are more prone to resource overruns [24]. Time-and-materials contracts—unlike fixed price contracts—do not penalize vendor firms for changes in client

requirements [32], therefore facilitating adaptation. We therefore included a dummy variable for *contract type* (1 for fixed price contract and zero for time-and-materials contracts). The *client's technical knowledge* (i.e., knowledge about software design and development) can influence its ability to govern the outsourced project [89]. This roughly corresponds to *client knowledge of the transformation process* in the IS project control literature [47]. We used five items from [89] (anchors: not at all—to a great extent) to tap into the client's understanding of system architectures, programming languages, detailed technical design, application development tools, and software development methodologies at the outset in the context of the outsourced project . Similarly, the vendor's understanding of the client's industry and business domain (*vendor domain knowledge*) can influence how effectively the vendor firm accomplishes project objectives [24]. Such domain knowledge is also recognized as an important input in the systems development process in the Scandinavian view of systems development [see 26]. This measure used four items to assess the vendor's understanding of the client firm's business rules and heuristics, business processes, day-to-day business routines, and a holistic understanding of the client's business at the outset of the project. The *software platform* on which the software is coded can also influence whether the vendor incurs a learning curve or can exploit existing economies of scale [24]. To account for this, we included four dummy variables to distinguish between *Windows*, *mainframe*, *Unix*, and *Web* platforms. The omitted category was *other*. *Windows* was subsequently dropped from the model due to a variance inflation factor of 5.06, which slightly exceeded the acceptable cutoff of 5.

In addition, we controlled for firm effects and industry effects to parcel out variance from such sources. We controlled for vendor capability maturity level (*CMM level*), which is a proxy for vendor project management capability [32]; *vendor firm age* (computed as 2006-year of

founding); a dummy for whether the vendor was an indigenous *Indian* firm or a joint venture or subsidiary of a foreign firm. To account for industry effects (e.g., technical and institutional variations across industry types discussed in [51: 213]), we included three dummy variables used by Ethiraj et al. [24] for client industry—*financial services*, *manufacturing*, and *retail* (omitting *other*). As Table 2 shows, all multi-item control variables exhibited acceptable psychometric properties.

### **Descriptive Statistics**

The primary respondents in the sample were highly experienced, as suggested by their average IT experience of 12.3 years (s.d. 6.68). On average, 56.1% of the vendor firms in the study had previously collaborated on a different project with the client. The sample represented a diverse array of vendor capabilities, as suggested by their CMM levels. Approximately 72% of the vendor firms did not have CMM certifications, while on the other hand 11.7% had the highest possible CMM level of 5. Approximately half of the firms were also ISO 9001 certified. 73% of the vendor firms were indigenous Indian firms, whereas the remaining were either joint ventures or subsidiaries of foreign firms. 26% of the projects used a time-and-materials (variable price) contract and the remaining used a fixed price contract. The software platforms associated with the outsourced projects leaned towards Windows (46%), followed by the Web (32%), and Unix (19%). The average duration of the outsourced project was 12.8 months (sd 11.1) and the number of individuals assigned full time to the project by the vendor averaged 25.8 (sd 49.5).

## **ANALYSIS AND RESULTS**

The analyses were conducted using a three-step hierarchical regression model. The control variables were introduced in step 1, followed by the main effects in step 2. The hypotheses were

tested in step 3, where three interaction terms between outcome, behavior, and clan control were added to the model. We used residual centering to reduce multicollinearity among the interaction terms and the main effects. This procedure corrects the problem of partial coefficient distortion encountered in the simultaneous analysis of main effects and interaction terms due to their correlation [45: 27]. The residual centered terms, which can directly be interpreted as standardized product terms in the regression procedure, were used in the analyses.

Although the residual centering procedure used for interaction effects regression models minimizes multicollinearity between main effects variables and interaction terms [45: 24], additional robustness tests were conducted to check for multicollinearity. The variance inflation factors (VIFs) are therefore also reported in the results in Table 3. VIFs are a regression diagnostic test for detecting multicollinearity problems [27: 11], to which models involving interaction effects can be particularly vulnerable. VIFs are akin to a ratio of “the strength of the signal relative to noise” in regression models [10: 191]. Both Belsley et al. [10: 93] and Hair et al. [37: 230] recommend using a cutoff of 10 for VIFs, suggesting that  $VIFs \leq 10$  indicate that multicollinearity is not a problem and those  $>10$  might be indicative of multicollinearity. Some researchers have recommended using a much more conservative cutoff of 5 instead of 10. All of our regression coefficients had VIFs below the 10 threshold. The highest VIF was 5.06 (i.e.,  $\geq 5$  but  $\leq 10$ ) for a dummy control variable “Platform-Windows.” We therefore dropped this control variable from the final analysis, and doing so did not change the significance of the results in the main analysis or in the post hoc analyses. This ensured that all final regression analyses for the main hypothesis tests as well as the post hoc tests met the more conservative cutoff of 5 for VIFs. This provides reasonable assurance against multicollinearity problems. The results of the hypothesis tests are summarized in Table 3.

<< INSERT TABLE 3 HERE >>

The control variables (step 1) were in the expected direction and explained 22.9% of the variance in systems development ambidexterity. Several of the control variables were nonsignificant, plausibly because they have previously not been used to predict systems development ambidexterity but only one of its underlying dimensions, nor used together in a single model. Of the main effects in step 2, outcome control ( $\beta = 0.19$ , T-value 1.54, ns) was nonsignificant and behavior control ( $\beta = 0.43$ , T-value 3.08,  $p < 0.01$ ) was positive and significant, suggesting that behavior control independently enhances systems development ambidexterity. The significant main effect of behavior control is consistent with Henderson and Lee's [40] results using classical efficiency and effectiveness measures in the context of internal systems development projects. The nonsignificant main effect of outcome control is consistent with the nonsignificant relationship with performance observed in outsourced projects in Tiwana and Keil's [90] recent empirical study. One interpretation for the nonsignificant main effect of outcome control is that performance clauses encompassed by outcome control are a common practice in outsourced project contracts, and one whose intent might be to safeguard against opportunism rather than to enhance performance per se. Furthermore, vendors might have an intrinsic disincentive to be opportunistic because it might wipe out opportunities for future contracts from that client. Since we did not measure opportunistic behavior by the vendor in this study, confirming that idea will have to await future work. The main effect of clan control was negative and significant ( $\beta = -0.36$ , T-value -2.86,  $p < 0.01$ ), suggesting that greater use of clan control, by itself, is associated with lower systems development ambidexterity. The main effects explained an additional 16.2% variance beyond the control variables. Note that the main effects cannot be interpreted in the presence of the interaction terms in step 3, where they represent

conditional simple effects [45: 24]. Such interpretations about the main effects must be restricted to step 2 and not extend to step 3, where interaction effects are present in the model.

The addition of interaction effects of clan control with outcome control and behavior control in step 3 tests the substitutes (H1) and complements (H2) hypotheses. Recall from our earlier discussion that a positive interaction effect indicates that the interacting variables are complementary whereas a negative interaction indicates that they are substitutes. In step 3, the interaction term between outcome control and clan control was negative and significant ( $\beta = -0.49$ , T-value  $-2.71$ ,  $p < 0.01$ ), supporting Hypothesis 1 (which proposed that they are substitutes). We explored this interaction further by testing the relationship between outcome control and systems development ambidexterity using a subsample where clan control values fell at least one standard deviation (1.23) below the mean (5.28) for clan control (i.e.,  $\leq 4.05$ ). This statistically represents a “low” level for clan control. Consistent with our theorizing, the relationship between outcome control and ambidexterity in a regression run for this subsample was positive and significant (beta  $.52$ , T-statistic  $2.51$ ,  $p < 0.01$ ). Therefore outcome control appears to enhance ambidexterity as long as the client does not simultaneously attempt high levels of clan control. However, as the results show, the simultaneous use of both diminishes the potential benefits of both. The interaction term between behavior control and clan control was positive and significant ( $\beta = 0.30$ , T-value  $2.03$ ,  $p < 0.05$ ), supporting Hypothesis 2 (which proposed that they are complements). The interaction terms accounted for a statistically significant increase in explained variance of 6.5% beyond the main effects.

We also conducted additional tests to address Ping’s [71] concern that when the quadratic terms of interacting predictors are not explicitly modeled, the significance tests of interaction terms can be less reliable. This concern has also been raised in the IS methodological literature

by Carte and Russell [15]. We therefore followed Ping's [71] (also Carte and Russell's [15: 483]) recommendation to add the quadratic terms of the interacting variables to the model in step 3. A change in the significance of the hypothesis tests from this step to a subsequent one where quadratic values of outcome, behavior, and clan control (the interacting variable) are included in the model would indicate that the significance tests of the interaction terms are not reliable. Adding these terms did not change the statistical significance or direction of the hypothesized relationships supported in step 3. Both (outcome control\*clan control;  $\beta = -0.51$ , T-value -2.65,  $p < 0.01$ ) and (behavior control\*clan control;  $\beta = 0.36$ , T-value 2.25,  $p < 0.05$ ) remained significant, consistent with step 3 in Table 3. Further, the quadratic terms of outcome control (T-value 0.58), behavior control (T-value 0.88), and clan control (T-value 0.96) were nonsignificant with a nonsignificant increase of 0.5% in explained variance (F-change for  $\Delta R^2_{Adj} = 1.12$ ). Therefore, the results are robust to the inclusion of quadratic terms, which are excluded because our objective was not to identify the functional form of the relationships, and to safeguard against model overspecification [45: 65].

We conducted additional post hoc analyses by separately examining the alignment and adaptiveness dimensions of systems development ambidexterity to further explore these relationships (see Table 4). The results provide additional insights into how different control mechanisms influence the underlying dimensions of systems development ambidexterity. Independent of interaction effects (step 1 in Table 4), behavior control was associated positively and significantly only with adaptiveness ( $\beta = 0.39$ , T-value 2.66,  $p < 0.01$ ; two-tailed test). A noteworthy insight here is that behavior control influences the adaptiveness dimension of ambidexterity. This directly complements Tiwana and Keil's [90] study that did not find behavior control to influence classic performance measures and shows that the benefits of this

control mechanism lie primarily in enhancing flexibility (which they did not capture). The lack of a relationship between outcome control and adaptiveness refines Carson et al's [14] recent observation that contract-based formal governance can be inflexible and not particularly adept at accommodating change. Clan control had a negative relationship with adaptiveness ( $\beta = -0.49$ , T-value  $-2.94$ ,  $p < 0.01$ ) and had no relationship with alignment. The interaction effects for alignment (step 2, Table 4) are remarkably consistent with overall systems development ambidexterity, and explained a significant level of incremental variance in alignment. These post hoc results are discussed in detail in the next section.

<< INSERT TABLE 4 HERE >>

The positive and significant main effect of behavior control (step 2 in Table 3), and its nonsignificant interaction effect with outcome control (step 3) supports our assertion that they might play distinctive roles in the systems development process. Nevertheless, the post hoc analysis (Table 4) does not fully support our expectation that outcome control would enhance alignment and behavior control would enhance adaptiveness. The increase in explained variance in each step in the model was statistically significant, suggesting that the concurrent complementarities and substitution effects between formal and informal control mechanisms contribute significant explanatory power to how project control portfolios engender systems development ambidexterity. Thus the two central hypotheses developed in the paper were strongly supported.

We also empirically confirmed that systems development ambidexterity positively influenced classical effectiveness and efficiency measures of software development performance. Systems development ambidexterity was significantly and positively related to meeting the project clients' assessments of systems development effectiveness i.e., whether the development

process was effective in successfully fulfilling the client's project objectives ( $r=.409$ ;  $p = .038 <.05$ ) and the client's quality expectations for the project ( $r=.465$ ;  $p = .017 <.05$ ) (as assessed by a manager in the client firm;  $N = 30$ ). Further, systems development ambidexterity was also significantly and positively related to classical measures of systems development efficiency including project completion on schedule ( $r=.181$ ;  $p = 0.032 <.05$ ) and within budget ( $r=.297$ ;  $p = 0.01$ ). Systems development ambidexterity is therefore associated with enhanced interfirm partnership performance, consistent with a similar finding in Gibson and Birkinshaw's [30] work in intrafirm settings. This suggests the theoretical usefulness of using systems development ambidexterity as a complement to—not a replacement for—classical performance measures used in the systems development literature.

### **Common Methods Bias Assessment**

We conducted four tests to assess the threat of common methods bias: Harman's one factor test [73], Lindell-Whitney's [55] marker variable test, intraclass correlation [81] between client and vendor dependent variable evaluations, and pairwise correlation analysis [6]. First, we performed Harman's one factor test, where the emergence of a single factor that accounts for a large proportion of the variance in factor analyses suggests a common methods bias [73]. A single factor did not emerge and the first factor accounted for 19.7% of the total 78.7% variance. Second, the marker variable test uses a theoretically unrelated "marker" variable to adjust the correlations among the principal constructs [55]. Any high correlation among any of the study's principal constructs and the marker variable would indicate common methods bias [57]. We separately repeated the test with two dummy marker variables theoretically unrelated to our principal constructs: (1) the count of vertical industry segments in which the controllee firm operated and (2) whether the project's software platform was Microsoft Windows. The average

correlation between the study's principal constructs for vertical segment count ( $r=.003$ ,  $T=.025$ ), and Windows ( $r=-.015$ ,  $T=-.084$ ) was low and nonsignificant, suggesting that common methods bias was not a problem. Third, we cross-validated client-vendor performance evaluations for the subsample for which matched pair data were collected. Since our attempt to collect matched pair performance data yielded only a 29.7% response rate ( $N=30$ ), the matched pair sample size was insufficient to directly rerun the model but sufficient to assess controller-controllee rater agreement using intraclass correlations. We used Shrout and Fleiss' [81] intraclass correlation coefficient (ICC), which measures consistency in the responses of client and vendor managers. The ICC value for the alignment dimension of systems development ambidexterity was 0.894 and the adaptiveness dimension of systems development ambidexterity was 0.879, suggesting high interrater agreement. Fourth, the pairwise correlation matrix (Table 2) did not indicate any exceptionally correlated variables. The highest correlation among the principal constructs is 0.42 which is below Bagozzi et al.'s [6] recommended 0.8 threshold. These four tests provide sufficient assurance that our results are not due to common methods variance. Given this, we used data from the primary respondents (project managers,  $N = 120$ ) for the hypothesis tests.

### **Limitations**

The results discussed in the next section should be interpreted with six limitations in mind. The cross-sectional design of the study precludes establishing causality or assessing the understudied dynamics of control. Future work using longitudinal or panel data should explore the dynamics of control, i.e., how the use of specific control mechanisms changes as a project progresses through various stages of the systems development lifecycle. It is theoretically plausible that some forms of control are more heavily used in the earlier stages of a project and others in later stages [see 16]. Second, although we controlled for both client and vendor firm knowledge, we

did not control for collaborative know-how that can also influence performance [83]. Third, consistent with the widely used classification of control mechanisms, we examined outcome, behavior, and clan control in the study [91]. However, we did not include vendor-driven “self control,” which is less widely recognized in the broader controls literature and which some theorists view as being synonymous with non-control [16, 17]. Fourth, some of our control variables are proximate but not identical to explanatory variables in the IS project controls selection literature [16, 46, 47]. For example, we entirely failed to control for vendor behavior observability, and used project goal codifiability as a proxy for outcome measurability and client technical knowledge as a proxy for client knowledge of the transformation process. Although none of these control variables have previously been established to explain systems development ambidexterity, this must be recognized as a limitation. Fifth, although the adjusted  $R^2$  values take model complexity into account, the relatively small sample size of 120 projects must be recognized as another limitation in light of the complexity of the model. Although the use of regression models for testing interaction effects is commonly accepted, its limitations relative to structural equation modeling due to the exclusion of error terms for interactions described by Ping [71] should also be noted as a limitation. Finally, caution is warranted in generalizing the results given that the vendors in the study were Indian IT firms. However, since an increasingly large number of US firms maintain offices and technical staff in India, the results are not likely be entirely idiosyncratic to the sampling frame. However, this raises a promising question for future research: Does the cultural distance between the client and vendor influence whether formal and informal control mechanisms complement and substitute each other? Is the pattern observed in this study robust across cultural settings? It is plausible, for example, that the perception of distrust associated with outcome control mechanisms might be more pronounced in

more collectivist cultures such as India and less so in more individualistic cultures. Similarly, clan control mechanisms might work better (i.e., a non-negative main effect) when the client and vendor are less culturally distant.

## DISCUSSION

The central theoretical idea explored in this paper was that the seemingly contradictory TCE and relational contracting perspectives that view formal and informal control mechanisms as substitutes and the interfirm adaptation perspective that views them as complements are mutually compatible, once some critical subtleties overlooked in prior work are fully taken into theoretical consideration. Our emphasis was on theoretically understanding within-portfolio interactions—specifically complementarities and substitution—between formal and informal control mechanisms in systems development projects.

Our theoretical development built on Ouchi's [65] neglected insight and Tiwana and Keil's [90] subsequent extension to systems development projects that formal control mechanisms depend on informational requirements. Although most prior work has considered only information that is required to put in place each type of formal control mechanism, we built on the recent observations that controls must also be enforced after being put in place using what we labeled evaluation information in order to be effective [14, 16, 18, 89]. This subtle distinction has largely been overlooked in the controls literature with the exception of a recent study that used it to introduce a theoretical distinction between attempted and realized control [90].

We theorized that when informal control mechanisms facilitate the client's access to *reliable* evaluation information for a specific formal control mechanism, they will complement it; if informal control mechanisms play no such facilitating role or only contradictory signals to the vendor, they will exhibit a substitutive relationship. We theoretically develop this idea by

building further on Tiwana and Keil's [90] interpretation of Ouchi's insight that enforcing formal outcome control and formal behavior control mechanisms requires different types of evaluation information, which was our subsequent conceptual basis for theorizing their interaction with informal control mechanisms.

The overarching contribution of this study is in reconciling the opposing complements versus substitutes perspectives by demonstrating that formal and informal control mechanisms can be *both* complements and substitutes in outsourced systems development projects. Our focus was on explaining the effects of such interactions among formal and informal control mechanisms on systems development ambidexterity i.e., the capacity to simultaneously exhibit alignment and adaptiveness in the systems development process. We showed that systems development ambidexterity, which is positively related to classical efficiency-effectiveness measures of performance, is a theoretically useful complement to them. This is a noteworthy departure from prior studies that have focused theoretically only on the main effects of controls on performance but completely overlooked effects of the interactions among different types of controls used within a project's control portfolio.

Analyses of data from 120 outsourced systems development projects showed that informal clan control mechanisms substitute for outcome control mechanisms but complement behavior control mechanisms. The results offer new insights into effects of control-portfolio-level interactions—complementarities and substitution effects—among formal and informal control mechanisms used to govern outsourced systems development projects. While recent research recognizes that misfits between the choice of controls and their usage context impose performance penalties [1, 90], we believe this is one of the earliest studies to directly examine

within-portfolio interactions of formal with informal control mechanisms. It also complements the contingency perspective invoked in prior IS research [e.g., 58].

Furthermore, our conceptualization of outsourced systems development performance in terms of systems development ambidexterity embraces the call to shift from an either/or perspective to a both/and perspective for reconciling governance paradoxes [85]. This is a significant departure from prior work, where interfirm adaptation has been assumed but not directly examined in conjunction with alignment in assessing outsourced systems development performance.

Although the shifting nature of project requirements is recognized in prior research [68], we complement that work with insights into how project control mechanisms also affect adaptation to such shifts. Our findings complement the IS project control literature, which has focused primarily on the choice of control mechanisms [46, 47, 62] and the effects of formal control separately on effectiveness and efficiency [40]. Our results complement Tiwana and Keil's [90] study that contrasted differences in the usage of various control mechanisms between internal and outsourced projects and their effects on performance; our focus was on the effects of interactions among formal and informal control mechanisms *within* a project's control mechanisms portfolio. Unlike their work, our results shed light on how chosen control mechanisms diminish and amplify each others' benefits. Our findings also complement the broader IT outsourcing literature, which has focused on the outsourcing decision [84, 88] and the performance impacts of interfirm processes [49, 53]. Our study is therefore distinctive in its focus on how the within-portfolio interactions among formal and informal control mechanisms influence outsourced systems development ambidexterity. The new insights into the concurrent complementarities and substitution effects between formal and informal control mechanisms

have two important theoretical implications for governing outsourced systems development projects.

### **Contributions and Implications for Research**

Figure 1 shows the interactions of formal controls with informal controls that are the focus of our key contribution.

<< INSERT FIGURE 1 HERE >>

First, the results show that formal outcome control mechanisms and informal clan control mechanisms have a substitutive effect on systems development ambidexterity in outsourced IT projects. The results show that outcome control decreases systems development ambidexterity with an increase in clan control. Figure 1a illustrates this interaction effect. The Y-axis represents systems development ambidexterity and the X-axis represents outcome control. The two interaction lines represent the relationships between these two variables for high and low levels of clan control. Interpreting the interaction effect depends on comparing the slope of the plots for high and low levels of the interacting variable (clan control) [22]. The high and low lines in the plot represent +3 and -3 standard deviations from the mean, and 1 and 2 standard deviations produced similar relationships that were less visually pronounced. As the plot shows in Figure 1 panel (a) shows, under greater clan control, the relationship between outcome control and systems development ambidexterity is weaker as indicated by the less steep slope of the solid line. When clan control is lower, this relationship is stronger, as indicated by the steeper dotted line. Thus, clan control and outcome control are substitutes.

This finding directly refines the TCE [1, 93, 95] and relational contracting [21, 36] perspectives that view contract-based formal controls and trust-based relational forms of control as mutual substitutes. However, contrary to these relatively-coarse arguments, clan control is not

a substitute for all types of formal control mechanisms; only for formal outcome control. This is consistent with our logic that the evaluation information needed for a client to enforce outcome controls is directly embedded in and can be objectively assessed from the project outputs delivered by the vendor without requiring clan controls. Informal clan control mechanisms do not influence the client's ability to reliably obtain such evaluation information. This finding also contradicts the existing coarser empirical observations that all forms of formal control complement trust-based informal control such as clan controls (e.g., [56, 61, 74]), which we show is true of only formal behavior control mechanisms. Furthermore, the negative signaling effects of outcome controls about vendor trustworthiness and perception of reliability can potentially induce dysfunctional vendor behavior, leading their interaction to decrease systems development ambidexterity.

Second, the results show that behavior control mechanisms complement clan control mechanisms i.e., their simultaneous use increases systems development ambidexterity beyond their effects in isolation. The results show that behavior control increases systems development ambidexterity with an increase in clan control. These two forms of control therefore reinforce each other. Figure 1b illustrates this interaction effect. Under greater clan control, the relationship between behavior control and systems development ambidexterity is stronger as indicated by the steeper slope of the solid line. When clan control is lower, this relationship is weaker, as indicated by the less steep dotted line. Thus, clan control and behavior control are complements.

This finding directly refines and supports the recent interfirm adaptation perspective that argues for their complementarity, and an assertion that is implicit in the IS project controls literature. However, it contrasts starkly with the prescriptions of the TCE and relational

contracting perspectives that view them as substitutes—an argument that holds true only for outcome control mechanisms rather than all forms of contract-driven formal control mechanisms. Relational contracts therefore do not necessarily preclude the existence of formal, process-oriented contracts. Our findings support our perspective that informal clan control mechanisms—at least in outsourced systems development with high asset specificity and non-equity arrangements—facilitate the client’s access to reliable behavior control evaluation information. We argued that the lack of formal authority, low observability (e.g., due to geographical dispersion, coordination overhead, and loss of communication richness), and high costs of monitoring require the client to heavily depend on self-reported evaluation information from the vendor. In these circumstances, trust, shared norms and goals, and bilateralism fostered by clan control can trump the vendor’s agency temptations, counter the sense of distrust that imposing behavior controls might signal, and motivate vendors to cooperate by providing reliable and accurate evaluation information to the client. As a corollary, clan control by itself matters little but it is powerful when used in combination with behavior control. From a systems dynamics perspective [79], the results also show that informal controls represents the feedback loops that allow the detection and correction of problems in outputs of a “system” (here, the project team) that lubricate the effectiveness of formal process control. In the context of the notion of “place” in the Scandinavian view of systems development [87], these results contribute complementary insights into the management of work across both organizational and national boundaries. Overall, these results only partially agree with Ring and Van de Ven’s [77] idea that relational (informal) contracts can replace market (outcome) *and* hierarchical (behavior) control mechanisms; we found support only for their first point. Carson et al. [14] observed that relational contracts, unlike formal ones, enable adaptation. Our results, in showing that they do

so only when complemented by formal behavior control, theoretically refine their idea. These findings also refine Goold and Quinn's [31] observation about trust being a prime prerequisite of effective control by showing that this is true for behavior control and clan control but not for outcome control.

Although the interaction between outcome and behavior control mechanisms was not the focus of our theory development, its absence (lack of statistical significance) is noteworthy from a theory development standpoint. Our expectation was that they would exhibit distinctive, independent effects on systems development ambidexterity but neither complement nor substitute for each other (i.e., no interaction effect). We expected that these two forms of formal control would serve distinctively different purposes since behavior control specifies how and outcome control specifies what the vendor should accomplish. Outcome control mechanisms evaluate vendor outputs without regard to the process through which they are achieved. In contrast, behavior control mechanisms evaluate vendor compliance with prescribed procedures and methods without regard to their outcomes. On these lines, Ouchi and Maguire [67] have previously suggested that outcome control and behavior control are "not substitutes," implying that their effects are mutually independent. In other words, their effects on systems development ambidexterity should be statistically additive. Outcome control should enhance alignment in project activities and behavior control should enhance adaptation. The absence of a significant interaction in Table 3 indeed supports their idea that outcome control and behavior control are not substitutes. However, the significant positive main effect of behavior control on adaptiveness but the absence of one for outcome control on alignment in our post hoc analysis in Table 4 fails to fully support the implicit notion that their benefits are also mutually independent.

## **Implications for Practice**

Although the results show how managers charged with designing outsourced project control portfolios can effectively combine formal and informal control mechanisms to enhance project performance, they also point to a previously-unrecognized dilemma. If formal outcome and behavior control mechanisms interact with clan control mechanisms in opposing directions, what is the appropriate combination of control mechanisms that is most likely to achieve the desired results? Since control is costly, rational managers ought to prefer governance mechanisms that successfully achieve project objectives at the least cost [1, 19]. Nevertheless, managers often attempt to hedge their risks in outsourcing arrangements by implementing a plethora of formal and informal control mechanisms—a strategy that our results caution can increase rather than decrease outsourcing non-performance risk due to the unanticipated, negative interactions *within a control portfolio*. Simply put, more is not necessarily better. We believe that the answer lies in limitedly invoking Ouchi's original insights about how contextual characteristics (such as measurability, observability, vendor knowledge) should guide the initial choice of formal control mechanisms. For example, behavior control mechanisms are attractive over outcome control mechanisms when any kind of output measurement is costly or difficult (e.g., in knowledge-intensive IT services outsourcing). Similarly, outcome control mechanisms are more attractive in contexts where outputs can be readily measured and the client lacks deep knowledge of the outsourced activity. Once the appropriate control mechanisms are put in place, they must also be enforced [90]. Since enforcing different types of formal control mechanisms requires specific types of evaluation information, managers can use the insights from this study to add complementary, non-substitutive combinations of informal control mechanisms to the control

portfolio. These considerations must also be coupled with the costs of implementing control, failing which these costs might wipe out the potential economic benefits of outsourcing.

From a pragmatic perspective, the key practical implication for managers arises from the complementary relationship between behavior control and clan control. Managers must recognize that the performance benefits of behavior control are strengthened by clan control. Therefore clients who attempt to have the vendor follow preferred methodologies, specific software development procedures, or prespecified practices (all behavior control mechanisms) should also simultaneously put in place informal control mechanisms to fully realize the potential benefits of the former. They can do this by actively participating in project meetings with vendor staff, on-site visits to or by the vendor, or by using dedicated project liaisons to interact with vendor employees (all clan control mechanisms) to ensure that the vendor better understands the client organization's goals, values, and norms.

In conclusion, the study shows that formal and informal interfirm control mechanisms can be both complements and substitutes. For managerial practice, this implies that within-portfolio interactions are perhaps as important as the initial choice of control mechanisms. The optimal configuration of control portfolios for outsourced projects is a matter of careful managerial judgment cognizant of the complementarities and substitution effects described here. More broadly, the study advocates a shift in the debate about whether formal and informal control mechanisms can simultaneously be used in outsourced systems development to how they can be used in mutually-reinforcing, non-conflicting combinations to enhance outsourced systems development.

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Table 1. Summary of theoretical logic for interactions of formal with informal control mechanisms.

	Formal Control Mechanism	
	Outcome Control	Behavior Control
Emphasis	What the vendor produces.	How the vendor produces it.
Evaluation question	Did the vendor meet the budget and schedule targets for final and intermediate project deliverables that were predefined by the client?	Did the vendor closely follow the systems development methods and procedures that the client recommended?
Negative signaling effects on the vendor resulting from the use of that formal control mechanism	Yes.	Yes.
Evaluation information needed to enforce it	Information about the timeliness and costs of the vendor's final and intermediate outputs.	Information about adherence to client-prescribed methods and procedures by the vendor.
How evaluation information is obtained by the client	<b>Objectively</b> ; inspection of vendor outputs by client to assess how well they meet the objective metrics and targets prespecified by the client.	At least partially <b>vendor-self-reported</b> information about the methods and procedures followed by the vendor.
Informal clan control's role in reliably acquiring such evaluation information	<b>Little to none</b> ; can be objectively assessed independent of clan control by comparing the timeliness, costs, and completeness of vendor outputs to predefined targets.	<b>Increases evaluation information reliability</b> . Socialization associated with clan control can foster bilateral cooperation and trust that can counter the negative signaling from using behavior control mechanisms; interaction associated with behavior control mechanisms can foster socialized acceptance of shared goals that are conducive to clan control. This decreases the likelihood that the vendor will misrepresent or withhold self-reported information about noncompliance with prescribed methods and procedures.
Relationship with clan control (statistical test)	Substitutive (negative interaction effect)	Complementary (positive interaction effect)

Table 2. Construct correlation matrix and descriptive statistics.

Construct	Mean	S.D.	α	Construct correlations																				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Systems development ambidexterity	33.03	8.45	a	—																				
2. Client-vendor ties	6.17	0.71	.85	.49***	—																			
3. Partnership history <sup>+</sup>	—	—	—	-.01	.08	—																		
4. Project scope	4.13	1.43	.89	.18	.12	.08	—																	
5. Project duration	11.14	8.85	—	-.03	-.10	.15	.26*	—																
6. Contract type <sup>+</sup>	—	—	—	.02	.00	-.04	-.22*	-.37***	—															
7. Client technical knowledge	4.49	1.31	.90	.10	.18	.09	.09	.18	-.19	—														
8. Vendor domain knowledge	4.91	1.34	.89	.16	.26*	.18	.05	-.01	-.11	.28**	—													
9. Platform: Mainframe+	—	—	—	-.17	.05	-.08	.01	-.16	.13	-.06	.12	—												
10. Platform: Unix+	—	—	—	-.15	-.03	-.16	.08	-.14	.01	.13	.13	.22*	—											
11. Platform: Web+	—	—	—	.04	.23*	.06	.05	.12	-.10	-.02	-.12	-.01	-.34***	—										
12. Vendor CMM level	0.99	1.87	—	-.23*	-.06	-.02	-.15	-.16	-.02	-.10	-.05	-.11	.28**	.02	—									
13. Vendor age	10.0	6.56	—	.00	.14	.06	-.30	-.28**	.19	-.11	-.01	-.20	.04	.15	.29**	—								
14. Vendor employee count	600	2175	—	.02	.09	.15	-.02	-.09	.09	-.06	.00	-.06	-.07	.27**	.39***	.24*	—							
15. Indian+	—	—	—	.23*	.00	-.17	-.06	-.09	.17	-.18	.09	-.04	.09	-.17	-.09	.14	.06	—						
16. Industry: Financial services+	—	—	—	-.01	.12	.12	-.04	.11	.05	.05	-.06	-.11	-.02	-.01	.20	.09	-.01	.05	—					
17. Industry: Manufacturing+	—	—	—	.02	-.07	-.22*	.01	-.12	.08	-.06	.13	-.09	.23*	-.08	.17	.24*	-.08	.08	-.22*	—				
18. Industry: Retail+	—	—	—	.22*	.12	-.01	-.28**	-.15	.15	-.08	-.10	-.05	-.14	-.06	-.13	.00	-.06	.15	-.13	-.11	—			
19. Project goal codifiability	5.28	1.20	.83	.14	.17	.11	.00	-.09	.22*	.07	.32***	.08	-.18	.07	-.13	-.09	.02	.01	.01	-.16	.03	—		
20. Outcome control	6.01	0.72	.63	.42***	.56***	.05	-.01	-.13	-.01	.05	.37***	.00	-.04	.19	-.04	.15	.09	-.05	-.10	-.02	.06	.28**	—	
21. Behavior control	5.70	1.05	.87	.37***	.40***	-.07	-.01	.08	-.21*	.27**	.46***	.09	.17	-.07	-.10	.11	.04	.00	.00	.19	-.01	.04	.33***	—
22. Clan control	5.28	1.23	.85	-.01	.30**	.26**	.18	.23*	-.02	.19	.01	-.07	-.10	.27	-.21*	-.05	-.16	-.22*	.00	-.12	-.02	.24*	.23*	.18

\*\*p< 0.01, \*p< 0.05 two-tailed test; <sup>+</sup> Dummy variable; N = 120 projects

<sup>a</sup> scale alpha for the alignment dimension of ambidexterity was 0.89 and adaptiveness was 0.85.

Table 3. Effects of interactions of formal with informal control mechanisms on systems development ambidexterity.

	<b>Step I</b> Control variables			<b>Step 2</b> Main effects			<b>Step 3</b> Interaction effects		
	$\beta$	<i>T-value</i>	<i>VIF</i>	$\beta$	<i>T-value</i>	<i>VIF</i>	$\beta$	<i>T-value</i>	<i>VIF</i>
(Constant)		-0.85			-1.97			-0.50	
Client-vendor ties	<b>.47***</b>	<b>3.72</b>	1.40	<b>.35*</b>	<b>2.65</b>	1.89	<b>.31*</b>	<b>2.37</b>	2.17
Relationship history	-0.04	-0.37	1.28	.12	1.07	1.49	.21	1.82	1.66
Project scope	.17	1.32	1.41	<b>.25*</b>	<b>2.20</b>	1.47	<b>.36**</b>	<b>3.10</b>	1.65
Project duration	-0.04	-0.34	1.48	-0.03	-0.24	1.59	-0.06	-0.56	1.61
Contract type (Fixed price =1)	.01	.05	1.48	.14	1.14	1.64	.24	1.99	1.83
Client technical knowledge	.03	.28	1.31	.06	.55	1.34	.07	.60	1.51
Vendor domain knowledge	.02	.14	1.65	-0.23	-1.67	2.12	-0.24	-1.87	2.13
Platform—Mainframe	-0.19	-1.58	1.32	<b>-.24*</b>	<b>-2.17</b>	1.39	-0.16	-1.43	1.50
Platform—Unix	-0.11	-0.81	1.64	-0.12	-0.94	1.70	-0.13	-1.06	1.78
Platform—Web	-0.07	-0.50	1.50	.07	.58	1.72	.14	1.18	1.85
Vendor CMM level	-0.14	-0.96	1.82	-0.04	-0.32	1.98	-0.02	-0.17	2.12
Vendor age	-0.06	-0.46	1.63	-0.14	-1.13	1.70	-0.12	-0.99	1.72
Vendor employee count	.05	.38	1.52	-0.14	-1.08	1.80	-0.22	-1.73	2.02
Indian	.19	1.54	1.32	<b>.22*</b>	<b>2.02</b>	1.38	<b>.30**</b>	<b>2.74</b>	1.46
Industry—Financial services	-0.02	-0.15	1.34	-0.07	-0.59	1.43	-0.10	-0.94	1.49
Industry—Manufacturing	.08	.60	1.47	-0.00	-0.001	1.59	-0.05	-0.44	1.65
Industry—Retail	.14	1.16	1.32	.12	1.06	1.33	.11	1.08	1.34
Project goal codifiability	.03	.27	1.40	.10	.87	1.49	.10	.87	1.66
Outcome control				.19	1.54	1.71	.01	.02	2.43
Behavior control				<b>.43**</b>	<b>3.08</b>	2.14	<b>.32*</b>	<b>2.36</b>	2.35
Clan control				<b>-.36**</b>	<b>-2.86</b>	1.79	<b>-.34**</b>	<b>-2.76</b>	1.94
Outcome control x Clan control							<b>-.49**</b>	<b>-2.71</b>	4.12
Behavior control x Clan control							<b>.30*</b>	<b>2.03</b>	2.78
Outcome control x Behavior control							.11	0.82	2.42
R <sup>2</sup> (Model F)	<b>43.3%*(2.12)</b>			<b>57.9%** (3.08)</b>			<b>64.8%*** (3.38)</b>		
R <sup>2</sup> <sub>Adj</sub>	<b>22.9%</b>			<b>39.1%</b>			<b>45.6%</b>		
$\Delta R^2_{Adj}$ (F-change)	—			<b>16.2%*** (5.43)</b>			<b>6.5%** (2.89)</b>		

\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05 two-tailed test; significant in **bold**; VIF represents variance inflation factor; N = 120 projects.

Table 4. Post hoc analyses of the effects of formal and informal control mechanisms on the two underlying dimensions of systems development ambidexterity.

	<b>Alignment dimension</b>				<b>Adaptiveness dimension</b>			
	Step 1 Main effects & control variables		Step 2 Interaction effects		Step 1 Main effects & control variables		Step 2 Interaction effects	
	$\beta$	$T$ -value	$\beta$	$T$ -value	$\beta$	$T$ -value	$\beta$	$T$ -value
(Constant)		2.91		3.86		-.12		.99
Client-vendor ties	<b>.33*</b>	<b>2.29</b>	<b>.29*</b>	<b>2.00</b>	<b>.3*</b>	<b>2.20</b>	.25	1.72
Relationship history	-.02	-.16	.05	.36	.19	1.59	<b>.26*</b>	<b>2.05</b>
Project scope	.11	.83	.20	1.60	.23	1.91	<b>.32*</b>	<b>2.55</b>
Project duration	-.07	-.50	-.10	-.77	-.01	-.03	-.04	-.29
Contract type (Fixed price =1)	.00	.01	.11	.79	.18	1.40	<b>.27*</b>	<b>2.05</b>
Client technical knowledge	-.06	-.50	-.01	-.09	.08	.68	.09	.71
Vendor domain knowledge	.01	.08	.01	.05	-.29	-1.96	<b>-.29*</b>	<b>-2.06</b>
Platform—Mainframe	-.14	-1.13	-.06	-.48	<b>-.24*</b>	<b>-2.04</b>	-.17	-1.44
Platform—Unix	.12	.88	.09	.70	-.19	-1.49	-.21	-1.64
Platform—Web	-.05	-.36	.04	.32	.12	.91	.17	1.25
Vendor CMM level	-.12	-.79	-.07	-.49	-.01	-.07	-.01	-.07
Vendor age	-.01	-.08	.01	-.01	-.19	-1.50	-.18	-1.38
Vendor employee count	.03	.25	-.07	-.48	-.19	-1.38	-.24	-1.69
Indian	.07	.53	.15	1.28	<b>.25*</b>	<b>2.13</b>	<b>.31*</b>	2.59
Industry—Financial services	-.07	-.53	-.12	-1.02	-.04	-.31	-.06	-.50
Industry—Manufacturing	-.01	-.04	-.07	-.51	.03	.21	-.02	-.18
Industry—Retail	.05	.41	.04	.36	.11	.94	.11	.97
Project goal codifiability	.23	1.76	.18	1.43	.02	.20	.03	.22
Outcome control	.13	.95	-.05	-.29	.20	1.57	.03	.21
Behavior control	.28	1.80	.17	1.08	<b>.39**</b>	<b>2.66</b>	<b>.32*</b>	<b>2.13</b>
Clan control	-.14	-.97	-.14	-1.00	<b>-.39**</b>	<b>-2.94</b>	<b>-.36*</b>	<b>-2.64</b>
Outcome control x Clan control			<b>-.49*</b>	<b>-2.44</b>			<b>-.43*</b>	<b>-2.18</b>
Behavior control x Clan control			<b>.42*</b>	<b>2.55</b>			.21	1.27
Outcome control x Behavior control			-.04	-.24			.08	.55
R <sup>2</sup> (Model F)	<b>47.2%*(1.99)</b>		<b>56.2%*(2.35)</b>		<b>53.1%*(2.53)</b>		<b>57.8%*(2.51)</b>	
R <sup>2</sup> <sub>Adj</sub>	<b>23.5%</b>		<b>32.3%</b>		<b>32.1%</b>		<b>34.8%</b>	
$\Delta R^2$ (F-change)	—		<b>8.7%***(3.01)</b>		—		2.7%(1.66)	

\*\*\*p< 0.001, \*\*p< 0.01, \*p< 0.05 two-tailed test; significant in **bold**; N = 120 projects.

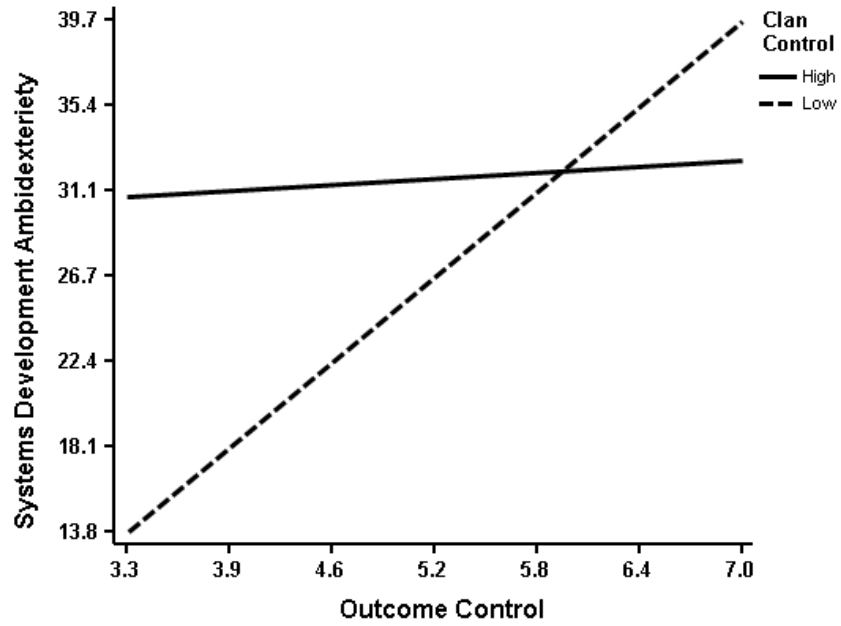


Figure 1a: Interaction effects of clan control mechanisms with outcome control mechanisms. High and low represent +3 and -3 standard deviations.

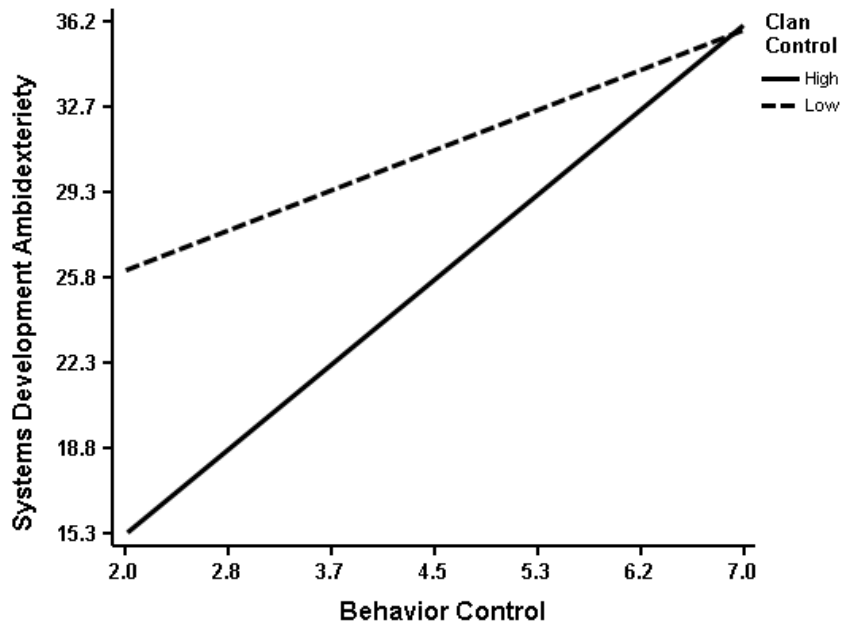


Figure 1b: Interaction effects of clan control mechanisms with behavior control mechanisms. High and low represent +3 and -3 standard deviations.

Appendix: Measures for all independent and dependent variables and their factor structure					
	1	2	3	4	5
Systems development ambidexterity was measured following Gibson and Birkinshaw [30] as the product of alignment and adaptiveness. <b>Systems development alignment</b> used four items (anchors: Strongly disagree—Strongly agree) that tapped into the extent to which the project development process was effective in successfully fulfilling the client’s project...					
...needs	<b>.891</b>	.125	.164	.024	.051
...objectives	<b>.872</b>	.048	.179	.118	.089
...quality expectations	<b>.834</b>	.171	.041	-.020	.147
...functional requirements	<b>.745</b>	.087	.270	.054	.103
The <b>adaptiveness</b> dimension used four items (anchors: Not at all—To a great extent) that assessed the extent to which it was possible to incorporate new requirements and design changes in response to changing client needs during each of the following successive project stages:					
1. requirements analysis	.098	<b>.735</b>	-.025	.074	.365
2. high-level design	.135	<b>.904</b>	-.062	.010	.151
3. detailed design	.103	<b>.912</b>	.110	-.042	-.070
4. development & coding	.066	<b>.710</b>	.185	-.070	-.172
All three control mechanisms were adapted from [47] and used strongly disagree—strongly agree as anchors. <b>Outcome control</b> was measured using three items that assessed the extent to which the client placed significant weight on...					
...timely project completion	-.020	.148	.148	.110	<b>.781</b>
...completion within budget	.303	-.055	.110	.083	<b>.708</b>
...accomplishing project goals	.516	.014	.083	.156	<b>.533</b>
<b>Behavior control</b> was measured using three items that assessed the extent to which the client expected the vendor to follow an understandable, written sequence of steps towards...					
...toward accomplishing project goals	.172	-.017	<b>.808</b>	.076	.352
...to ensure the system met the client’s requirements	.189	.093	<b>.887</b>	.140	-.002
...to ensure the success of the project	.257	.134	<b>.826</b>	.186	.078
<b>Clan control</b> was measured using three items (anchors: Strongly disagree—Strongly agree) that assessed the extent to members from the client firm...					
...attempted to be “regular” members of the project team	.019	.063	.104	<b>.866</b>	.047
...placed a significant weight on understanding the project team’s goals, values, and norms	.116	-.045	.023	<b>.887</b>	.089
...actively participated in project meetings to understand the project team’s goals, values, & norms	.041	-.072	.245	<b>.833</b>	.149
<b>Eigenvalue</b>	5.2	2.7	2.0	1.5	1.2
<b>% variance explained by factor</b>	19.7%	16.5%	14.2%	13.9%	10.5%