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Governance-Knowledge Fit in Systems Development Projects

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This study addresses the theoretically underexplored question of how fit between project governance configurations, and the knowledge of specialized information technology (IT) and client departments, influences information systems development (ISD) performance. It conceptualizes project governance configurations using two classes of project decisions rights—decision control rights and decision management rights. The paper then develops a middle-range theory of how governance-knowledge fit shapes ISD performance by influencing the effective *exercise* of these decision rights during the development process. Further, the two dimensions of ISD performance—efficiency and effectiveness—are shaped by different classes of project decision rights. Data from 89 projects in 89 firms strongly support the proposed ideas. Implications for theory and practice are also discussed.

Key words: systems development; project governance; decision rights; governance-knowledge fit; middle-range theory; project management
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1. Introduction

Effective IT governance is the single most important predictor of how much value firms derive from their IT investments (Weill and Ross 2004). A central question in IT governance is about how responsibilities for various IT decisions (*decision rights*) should be shared between IT and client departments (Marwaha and Willmot 2006, Ross et al. 1996, Weill and Ross 2004). Although prior IT governance research has provided insights into governance arrangements at the IT function level (Brown 1997, Sambamurthy and Zmud 1999, Tavakolian 1989), it has overlooked the subtlety that governance configurations appropriate for different projects do not necessarily mirror those used for the IT function (Mähring 2002, Xia and Lee 2004). The focus on IT functions as the unit of analysis therefore theoretically obscures the subtleties surrounding governance at the project level (Mähring 2002).

Specialization within IT and client departments exacerbates such project governance challenges in another underappreciated way: The IT unit generally has the technical expertise but lacks the line function's depth of domain knowledge, and vice versa. This has led Mähring (2002) to characterize information systems development (ISD) as a process of managing with inferior task knowledge and implementing with inferior domain knowledge. Such knowledge has important implications for how effectively project control (e.g., ratification and monitoring) and project management (e.g., resource utilization and implementation) activities can be accomplished. Notably, project governance choices can estrange project decision rights from the expertise that might be necessary for effectively exercising them. The interactions among project governance configurations and IT/client departments' knowledge therefore represents a gap in the IT governance literature. This study seeks to address this gap, guided by the following research question: How does fit between project governance configurations, and IT and client departments' knowledge influence systems development performance at the project level?

The paper conceptualizes a project's governance configuration as centralization/decentralization of two classes of project decision rights—decision control rights (DCRs) and decision management rights

(DMRs). The theory development introduces the central mediating concept of decision rights *exercise* effectiveness, building on Jensen and Meckling's (1992) model to conceptualize two types of governance-knowledge fit. Fit between the client department's technical knowledge and DCR decentralization enhances the effectiveness with which project activities encompassed by DCRs—project ratification and monitoring—are accomplished, which in turn influences ISD efficiency. Fit between the IT unit's business application domain knowledge and DMR centralization influences the effectiveness with which project activities encompassed by DMRs—implementation and resource utilization—are accomplished, which in turn influences ISD effectiveness. Data from 89 ISD projects in 89 firms strongly support the proposed ideas.

This paper makes two original contributions to the IT project governance literature. First, it shows how two different types of governance-knowledge fit at the project level enhance the effective exercise of two classes of project decision rights, which in turn mediates the effects of IT/client departments' knowledge on ISD performance. Second, it shows that ISD efficiency and effectiveness are influenced by the effective exercise of *different* classes of project decision rights. Collectively, these findings significantly extend a fledgling, exploratory research stream on IT project governance (Henry 2004, Mähring 2002), contribute a novel project-level theory to the IT governance literature, and complement prior work on information systems (IS) project control (Choudhury and Sabherwal 2003; Kirsch 1996, 1997; Kirsch et al. 2002).

The paper proceeds as follows. Section 2 develops the hypotheses. This is, followed by the methodology (§3), the analyses (§4), and a discussion of the results (§5). The paper concludes with a summary of its theoretical and practical implications.

2. Theoretical Development

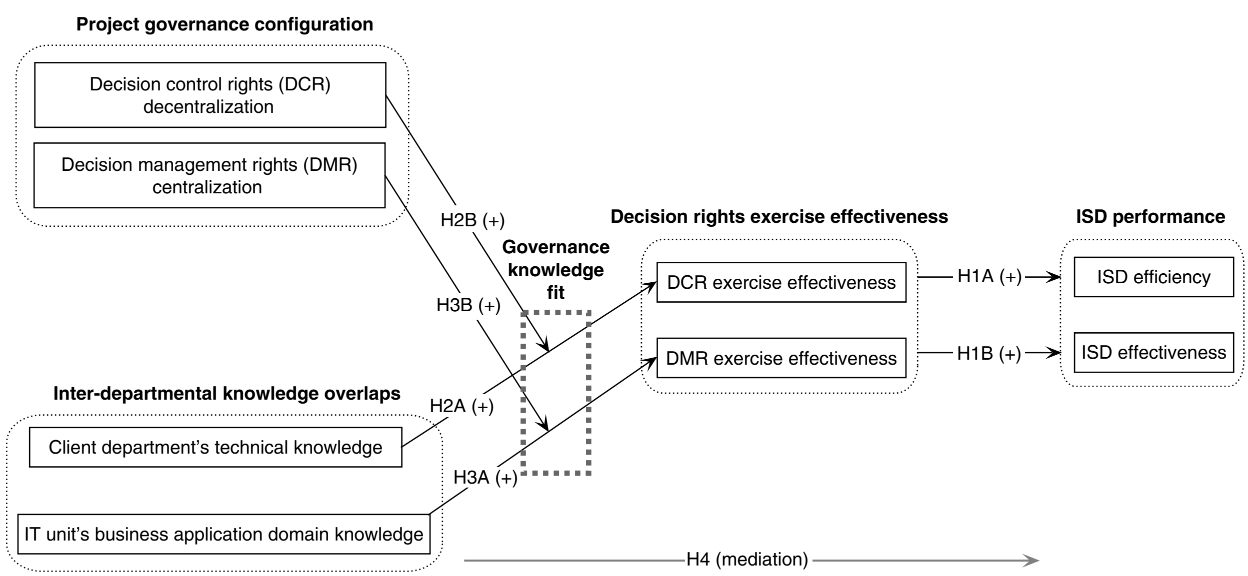
Figure 1 summarizes the research model underlying the proposed middle-range theory of governance-knowledge fit, which is developed next.

2.1. Project Governance Configurations as Decision Rights in Systems Development

A central element of governance is decision rights (Anand and Mendelson 1997, Nault 1998), which are defined as decision-making authority (Dessein 2002, Jensen and Meckling 1992). Building on Sambamurthy and Zmud's (1999) conceptualization of IT governance, project governance configurations can be conceptualized in terms of interdepartmental (IT/client) centralization/decentralization of the key classes of project decision rights.

Fama and Jensen's (1983) work provides a useful starting point for delineating different classes of

Figure 1 **The Research Model**



decision rights in ISD projects. They identify four types of activities encompassed by decision rights in organizations: (a) ratification/approval, which they define as the choice and approval of the initiatives to be implemented; (b) monitoring, which relates to the specification and implementation of performance measurement criteria; (c) initiation, which they define as utilization of organizational resources; and (d) implementation, which they describe as execution of ratified decisions. They cluster ratification and monitoring activities under the umbrella of *decision control* because they are typically allocated to the same agent. Similarly, they combine initiation and implementation activities as *decision management*.

The conceptualization of these two classes of decision rights is broadly consistent with the product development, ISD, and operations literature. For example, the distinction between DCRs versus DMRs parallels the distinction between decisions in setting up a project versus decisions within a project (Krishnan and Ulrich 2001), specification versus production decisions in product development (Iyer et al. 2005), specification versus execution decision rights in operations management (Vazquez 2004), and the distinction between control *over* a project versus control *within* a project in the ISD literature (Mähring 2002).

Consider how the two classes of decision rights in Fama and Jensen's (1983) framework translate into an ISD project context. *Decision control rights* (*DCRs*) encompass project ratification and monitoring activities. In ISD projects ratification and monitoring involves establishing rewards and penalties for project outcomes, and implementing mechanisms to evaluate the project team's performance, specifying project milestones and deliverables, and monitoring project progress. DMRs encompass project implementation and accompanying resource utilization activities for the ratified project. In ISD projects, implementation and initiation involves activities such as systems design; software architecture design; selection of a software platform, development methodology, and programming language; and the definition of application features/functionality. DMRs therefore define how the ratified project objectives are realized.

Both Fama and Jensen (1983) and Jensen and Meckling (1992) emphasize that agency considerations require decision control and decision management to be allocated to different agents i.e., a single agent should not *exclusively* possess have both classes of decision rights. However, a clear-cut dichotomous ownership for either class of decision rights rarely exists in ISD practice; and they are usually shared to varying degrees by the IT and client departments (Kirsch and Beath 1996, Ross et al. 1996, Sambamurthy and Zmud 1999, Weill and Ross 2004), with *greater* ownership by one department. The department with greater ownership—the *locus* of a class of decision rights—has greater *but nonexclusive* authority for the associated project activities. It is therefore more meaningful to conceptualize project governance configurations in terms of degrees of centralization/decentralization of the two classes of decision rights rather than a dichotomy. The greater the degree to which a class of decision rights is centralized (decentralized), the greater the responsibility held by the IT unit (client department) for the associated activities, with the other department providing input.

The interdepartmental centralization/decentralization of the two classes of project decision rights here represent the governance configuration for a specific project. This conceptualization therefore explicitly recognizes that both client and IT departments actively participate in IT projects (Baronas and Louis 1988, Ives and Olson 1984).

2.2. The Influence of Decision Rights Exercise on ISD Performance

To theorize how project governance configurations influence ISD performance, one must first consider how the accomplishment of the activities encompassed by each class of project decision rights influences performance. Building on Jensen and Meckling (1992), *decision rights exercise effectiveness* is broadly defined as *how well the activities encompassed by either of the two classes of project decision rights are accomplished during the ISD process*. Project performance encompasses two dimensions (Krishnan and Ulrich 2001), ISD efficiency and ISD effectiveness. ISD efficiency is defined as the extent to which a project is completed on schedule, within budget, and with minimal extraneous rework (Nidumolu 1995). ISD effectiveness is defined as the extent to which the project satisfactorily fulfills the client department's needs (Kirsch and Beath 1996). Consider next how the effective exercise of the two classes of decision rights influences ISD performance.

DCR exercise effectiveness is defined as how well project ratification and monitoring activities—the activities encompassed by DCRs—are accomplished during the ISD process. Such decision rights encompass activities including specifying a project budget specification, setting a project schedule, laying out project expectations, and establishing project milestones and deliverables. Therefore, the more effectively these project activities are accomplished, the more likely it is that appropriate targets, and realistic project expectations, feasible schedules, and sufficient resource allocation will characterize the development process. Effective exercise of project DCRs will therefore enhance compliance with project resource constraints (e.g., budget and schedule)—that is, improve the overall efficiency with which project outcomes are achieved. Effectively accomplishing project ratification and monitoring activities, however, is less likely to directly influence whether the completed system satisfactorily fulfils the client department's needs or solves the intended problem. Therefore, effective exercise of DCRs is unlikely to influence ISD effectiveness. This leads to the first hypothesis.

Hypothesis 1A (H1A). *Project decision control rights DCRs exercise effectiveness will be positively associated with ISD efficiency.*

DMR exercise effectiveness is defined as how well project implementation and initiation activities—the activities encompassed by DMRs—are accomplished during the ISD process. In ISD projects, such activities encompass the development of the system architecture and design, selection of a development methodology, choice of programming language, and the implementation of features and functionality implemented in the system. Therefore, the more effectively these project activities are accomplished, the more likely it is that the project implementation decisions (choice of features, functionality, and system performance levels) will be aligned with the intended project objectives and that project outcomes will better fit the needs of the client department. In short, the system is more likely to do what it was intended to do. In contrast, poor exercise of DMRs can lead to project outcomes that might be technically adequate, and compliant with budget and schedule constraints, but provide ineffective solutions to the client's problem. Effective exercise of project DMRs will therefore enhance ISD effectiveness. However, effectively accomplishing project initiation and implementation activities is less likely to directly influence whether the project is completed within budget or on schedule. Therefore, effective exercise of DMRs is not expected to directly influence ISD efficiency. This leads to the next hypothesis.

Hypothesis 1B (H1B). *Project decision management rights DMRs exercise effectiveness will be positively associated with ISD effectiveness.*

2.3. Conceptualizing Fit Between Project Governance Configurations and IT/Client Department Knowledge

2.3.1. An Overview of the Jensen-Meckling Theory. The Jensen-Meckling (1992) model provides a theoretical lens for conceptualizing the fit of project governance configurations with IT/client department knowledge. The crux of their model is that decision rights must be colocated with the knowledge required to exercise those decision rights to facilitate effective decision-making. When knowledge and decision rights are not colocated, it is necessary to move either the decision rights to the locus of knowledge or that knowledge to the locus of decision rights. The overarching theme in Jensen-Meckling's theory is therefore to place more decision-making authority in the department where pertinent knowledge is the highest.

Following Jensen-Meckling, effective decision-making in ISD projects can be conceptualized as how effectively the activities encompassed by each class of project decision rights are accomplished during the ISD process, or decision rights *exercise effectiveness*. The loci of the two classes of decision rights are different departments, both because of the agency considerations described by Jensen-Meckling and because of the intrinsic need for the two departments to specialize in complementary but differentiated activities. Building on Fama and Jensen's (1983) observation, organizations reduce coordination costs by delegating initiation and implementation activities to agents with valuable relevant knowledge (here, the IT unit), and mitigate agency problems by separating the management (initiation and implementation) and control (ratification and monitoring) of decisions. In other words, each class of decision rights is likely to lean—nonexclusively—towards the department that has stronger incentives to perform the associated activities as well as the *primary* knowledge needed to perform them. Consider how these factors influence the preferred locus of each class of project decision rights.

DCRs in internal ISD projects usually lean toward decentralization; i.e., their locus is the client department, to which the IT unit provides some input (Nidumolu and Subramani 2004). The agency explanation for this tendency is that it is unrealistic for the IT unit to independently ratify and monitor—i.e., both establish and monitor the project budget, schedule, and deliverables. The client department has stronger incentives to carefully ratify and monitor the project because it usually bears the consequences of the project's outcomes. The knowledge explanation is that the client department is likely in a better position to determine a project's business constraints (e.g., schedule, budget), objectives, scope, and priorities (Sambamurthy and Zmud 1999). This tendency is well documented in the IS control literature, where the client typically assumes *some* responsibility for project control (Choudhury and Sabherwal 2003; Kirsch 2004, 1997).

DMRs usually lean toward centralization; i.e., their locus is the IT unit, to which the client department provides input. This is because the IT unit is more likely to have the incentives for performing software development/implementation well (the agency driver) and to possess the technical expertise for systems development and implementation (the knowledge driver) (Hann and Weber 1996).

Overall, a leaning towards DCR decentralization and DMR centralization places each class of decision rights closer to the locus of the *primary* type of knowledge that is needed to exercise them and also mitigates agency problems. However, it paradoxically introduces a challenge for ISD because unexplicated knowledge relevant to *both* project DCRs and DMRs is dispersed across the IT and client departments (Rus and Lindvall 2002). Two types of knowledge are relevant to the ISD process: (1) technical knowledge, which is defined as knowledge about design, programming, and software development processes, and (2) business application domain knowledge, which is defined as knowledge about the business processes, business rules, policies and procedures, and the business objectives associated with the project's problem domain (Adelson and Soloway 1985, Choudhury and Sabherwal 2003, Kirsch and Beath 1996, Rus and Lindvall 2002, Tiwana 2001). The former type of knowledge resides primarily—but not exclusively—in the IT unit and the latter in the client department, consistent with the logic of departmental specialization in complementary but differentiated activities (Dessein 2002). For example, the client department is likely to better understands what the application should do to support its associated business processes, i.e., has higher knowledge of the business application problem domain (Kraut and Streeter 1995). Likewise, the IT department is likely to have better knowledge of how to design and build the application, i.e., has greater technical knowledge. However, when an activity requires coordination of multiple interdependent knowledge bases, they are mutually complementary (Marengo et al. 2000). In ISD projects, technical and application domain knowledge are complementary because both must be utilized in the development process to devise an effective ISD solution (Faraj and Sproull 2000). Although both departments are likely to have the primary type of knowledge necessary for exercising the decision rights for which they are likely to have greater responsibility, neither is likely to possess the full range of *complementary* expertise required to effectively exercise either class of decision rights (e.g., technical knowledge in the client department or application domain knowledge in the IT unit).

Following Venkatraman's (1989) moderation perspective of fit, governance-knowledge fit is conceptualized as an interaction among decision rights de/centralization and IT/client department knowledge. This conceptualization is appropriate when fit is theoretically anchored to a particular criterion variable (e.g., decision rights exercise effectiveness), the concept has high theoretical specificity, and the interaction between the predictor and moderator is the primary determinant of the criterion variable. Therefore, fit is analyzed as the interaction effect of the predictor and moderator on the criterion variable, identical to the notion of complementarities as a positive interaction effect, wherein more of one variable makes more of the other more valuable (Siggelkow 2002, Tiwana 2008). Consider next the types of knowledge that are required to effectively exercise each class of project decision rights, which is the basis for conceptualization of governance-knowledge fit.

2.3.2. Governance-Knowledge Fit. Table 1 summarizes the forthcoming logic, that, in addition to knowledge in its own domain, if a given department also has complementary knowledge about the other department's domain, the problem of distancing of knowledge from decision rights can be attenuated.

Fit between project decision control rights DCRs and technical knowledge. Paradoxically, the IT unit usually has the technical expertise to better judge project budget, schedule, and resource needs, although the aforementioned agency and knowledge considerations push towards decentralization of project ratification and control activities, i.e., DCRs. With greater DCR decentralization, the client is likely to encounter the knowledge-distancing problem about which Jensen-Meckling caution, because effectively accomplishing project ratification and control activities also requires complementary technical knowledge. Effectively accomplishing such project activities entails establishing realistic rewards and penalties for project outcomes, allocating sufficient resources (such as budget, schedule, and personnel), and understanding the constraints and possibilities of the underlying technologies. Client departments often lack such knowledge because it is associated with the IT unit's specialty (Kirsch et al. 2002). Greater DCR decentralization thus colocates DCRs closer to the locus of the primary type of knowledge but distances them from complementary technical knowledge (see Table 1).

To solve this problem the client department should possess a relatively higher level of technical knowledge just to more effectively accomplish project ratification and monitoring activities, i.e., to effectively exercise project DCRs. This can be viewed as fit in the Jensen-Meckling sense between DCRs and knowledge. Prior research has also demonstrated the downstream effects of such knowledge in IT activities, including: improved IT alignment (Reich and Benbasat 2000), better project control (Kirsch et al. 2002, Tiwana and Keil 2007), and enhanced IT unit effectiveness (Armstrong and Sambamurthy 1999, Nelson and Cooprider 1996). Therefore, greater technical knowledge in the client department enhances the effectiveness with which project ratification and monitoring activities encompassed by DCRs are accomplished during the ISD process. Furthermore, this relationship is moderated (strengthened) by decentralization of project DCRs. The positive interaction between client department technical knowledge and DCR decentralization therefore corresponds to interaction-based fit, with DCR exercise effectiveness

Table 1 **A Jensen-Meckling Analysis of Governance Configurations in Systems Development Projects**

	Class of project decision rights	
	Decision control rights (DCR)	Decision management rights (DMR)
Project activities encompassed	Project ratification and monitoring	Project initiation (utilization of project resources) and implementation.
Locus of decision right if centralized (decentralized)*	IT unit (**Client department**)	**IT unit** (Client department)
Primary knowledge needed to effectively exercise this class of decision rights	Business knowledge including project resource (e.g., schedule, budget) constraints and targets.	Technical implementation knowledge including software design, programming, and development expertise.
Complementary knowledge needed to effectively exercise this class of decision rights	Technical knowledge for ratification (e.g., establishing realistic project goals, allocating appropriate resources) and monitoring (e.g., evaluating intermediate deliverables and project outcomes).	Business knowledge of the application domain of the project.
Dimension of ISD performance directly influenced by the exercise of this class of project decision rights	ISD efficiency	ISD effectiveness

*The theoretically expected locus of each class of decision rights appears in bold.

as the criterion variable. This leads to the next set of hypotheses.

Hypothesis 2A (H2A). *An increase in technical knowledge in the client department enhances the effectiveness with which project decision control rights are exercised during the ISD process.*

Hypothesis 2B (H2B). *Decision control rights decentralization positively moderates the relationship between the client department's technical knowledge and decision control rights exercise effectiveness.*

Fit between project decision management rights and business application domain knowledge. Paradoxically, the client department usually has better knowledge of the project's idiosyncratic problem domain, although the aforementioned agency and knowledge considerations push towards centralization of project implementation activities, i.e., DMRs. However, effectively accomplishing project implementation activities also requires knowledge of the particular client department processes and practices to which the software application will be applied (Weill and Ross 2004), which is often outside the IT unit's domain. Greater DMR centralization thus colocates DMRs closer to the locus of the primary type of knowledge but distances them from complementary business application domain knowledge (see Table 1).

To solve this problem, the IT unit should possess a relatively higher level of business application domain knowledge—in addition to technical knowledge—just to more effectively accomplish project initiation and implementation activities, i.e., for effectively exercising project DMRs. This can be viewed as fit in the Jensen-Meckling sense between DMRs and knowledge. Therefore, greater business application domain knowledge in the IT unit enhances the effectiveness with which initiation and implementation activities encompassed by DMRs are accomplished during the ISD process. Furthermore, this relationship is moderated (strengthened) by centralization of project DMRs. The positive interaction between the IT unit's application domain knowledge and DMR centralization therefore corresponds to interaction-based fit, with DMR exercise effectiveness as the criterion variable. This leads to the next set of hypotheses.

Hypothesis 3A (H3A). *An increase in the IT unit's application domain knowledge enhances the effectiveness with which project decision management rights are exercised during the ISD process.*

Hypothesis 3B (H3B). *Decision management right centralization positively moderates the relationship between the IT unit's application domain knowledge and decision management rights exercise effectiveness.*

The mediating role of decision rights exercise effectiveness. Interdepartmental knowledge overlaps influence ISD performance primarily *because* they it influences how effectively the two classes of project decision rights are exercised during the ISD process. Higher technical knowledge in the client department facilitates better exercise of decision rights pertaining to project ratification and monitoring activities. Client technical knowledge therefore improves ISD efficiency *because* it enhances DCR exercise effectiveness. Similarly, higher business application domain knowledge in the IT unit lowers the likelihood of misconstruing the client department's needs and making project implementation decisions that are inconsistent with the client's objectives; i.e., it enhances the exercise of decision rights associated with project initiation and implementation activities. Such knowledge therefore improves ISD effectiveness *because* it enhances DMR exercise effectiveness. The foregoing logic leads to the final set of hypotheses.

Hypothesis 4A (H4A). *The effect of the client department's technical knowledge on ISD efficiency is fully mediated by decision control rights exercise effectiveness.*

Hypothesis 4B (H4B). *The effect of the IT unit's business application domain knowledge on ISD effectiveness is fully mediated by decision management rights exercise effectiveness.*

3. Methodology and Data Collection

A survey of 89 internal application development projects in 89 firms was conducted in 2003–2004 to test the hypothesized relationships. Three considerations motivated the focus on internal projects. First, interorganizational characteristics would have added an untenable layer of conceptual complexity. Second, prior work (e.g., Henderson and Lee 1992, Kirsch et al. 2002, Nidumolu 1995) from which the control variables are drawn also examined internal projects. Third, internal development suppresses decision rights alienability that overcomes decision rights allocation problems in market arrangements (Jensen and Meckling 1992).

The sampling frame was a random sample of "MIS directors" in 496 U.S. firms, drawn from Dun and Bradstreet's directory of executives, who were contacted to collect project-level data. To mitigate confounding effects, only projects involving a single client department were studied. 93 of the 496 IS directors contacted participated, yielding a response rate of 18.75%. Of these, four projects with missing data were dropped. Matched-pair performance data were also collected from client managers for 37 projects of these 89 projects. The respondents represented a variety of industries, including industrial products distribution, manufacturing, services, pharmaceuticals, engineering, construction, and telecommunications. T-tests comparing the early (first 30) and late (last 30) respondents revealed no statistically significant differences in firm characteristics (firm size $T = -1.32$; revenue $T = -1.13$), project characteristics (duration ($T = -0.37$) and team size ($T = -0.08$)), or the number of projects completed by the IT unit for the client department ($T = 0.29$), suggesting that nonresponse bias was not a persuasive threat.

3.1. Construct Operationalization and Scale Development

All scales were operationalized at the project level as summarized in Table 2. The questionnaire items and the respondent(s) are shown in the appendix. All key constructs were measured using multi-item, Likert or Guttmann scales. New scales were developed for decision rights centralization/decentralization and decision rights exercise effectiveness, using Fama and Jensen's (1983) definitions of decision control and decision management as the conceptual starting point. A preliminary pool of measurement items anchored in the ISD context was refined using feedback from IT managers in 14 firms and from six academic experts. This ensured that the items were meaningful in the ISD context and were unambiguous.

DMR centralization used seven items that assessed the extent to which the IT unit vis-à-vis the client department had greater responsibility for project initiation and implementation activities. Higher (lower) scores mean that the IT unit (client department) was nonexclusively responsible for these activities to a greater degree than the client department (IT unit). *DCR decentralization* used three items that assessed the extent to which the client department had greater responsibility vis-à-vis the IT unit for project ratification and monitoring activities. Higher scores mean that the client department was responsible for these activities to a greater degree than the IT unit.

While this conceptualization of governance configuration explicitly takes into account whether and how both classes of project decision rights are shared by the two departments, the measures of decision rights exercise assess the effectiveness with which the associated activities were accomplished during the ISD process at the project level. *DMR exercise effectiveness* used six items that tapped into how appropriately project implementation/initiation activities were accomplished at the project level. No assertion about which department made these decisions was embedded in the DMR exercise effectiveness measure. *DCR exercise effectiveness* used five items that tapped into how appropriately project ratification and monitoring activities were accomplished. This scale makes a reasonable assertion that project ratification and monitoring was done to a greater extent by the client department. This is consistent with the idea that while both departments play some role in exercising each class of decision rights, the most appropriate anchor at the project level for their exercise effectiveness is the principal rather than the agent. *IT unit's business application domain knowledge* and *client department's technical knowledge* each used six-item scales from Tiwana (2003). Following Nidumolu (1995), *ISD efficiency* was measured as deviation in schedule, cost, and development and programming effort relative to the original plan. *ISD effectiveness* was measured by adapting the Tiwana (2003) six-item scale for both IT and client department respondents. ISD efficiency and effectiveness data from the IT respondents were used for the model tests, and that data from the client were used solely to assess common methods bias (see §4.3). Control variables' measures and their sources are described in the appendix.

Table 2 A Summary of the Key Constructs and Their Measures

Construct	Definition	No. of items	Informing sources...
DCR decentralization	The extent to which the decision rights associated with project ratification and monitoring activities lean more towards the client department vis-à-vis the IT unit.	3	
DMR centralization	The extent to which the decision rights associated with project initiation and implementation activities lean towards the IT unit vis-à-vis the client department.	7	
DCR exercise effectiveness	How well project ratification and monitoring—the activities associated with project DCRs—are accomplished during the ISD process. Such activities include project budget and schedule specification, establishing project expectations, and establishment of milestones and project deliverables.	5	Newly developed scales; conceptually derived from Fama and Jensen (1983).
DMR exercise effectiveness	How well project initiation and implementation—the activities encompassed by project DMRs—are accomplished during the ISD process. Such activities include system architecture development and design, development methodology selection, choice of programming language, and implementation of the desired features and functionality in the system.	6	
IT unit's business application domain knowledge	The IT unit's knowledge of the business processes, business rules, policies and procedures, and the business objectives associated with the project's problem domain.	6	
Directly used from Tiwana (2003)			
Client department's technical knowledge	The client department's knowledge of software design, programming, and software development processes.	6	
ISD efficiency	The extent to which a project is completed on schedule, within budget, and with minimal extraneous rework.	3	(Kirsch and Beath 1996, Nidumolu 1995)
ISD effectiveness	The extent to which the completed system satisfactorily fulfils client department needs.	6	Adapted from Tiwana et al. (2003)

4. Results

Partial least squares (PLS) structural equation modeling was used to validate the measurement model and then to test the hypotheses using Smart-PLS 2.0.

4.1. Measurement Model Assessment

Convergent and discriminant validity for the scales were assessed before the structural model was tested. Construct correlations, means, and standard deviations are summarized in Table 3.

High scale Alphas (≥ 0.84) and item loadings (≥ 0.7) in the measurement model suggest that the scales had high convergent validity and reliability. Discriminant validity was indicated by three assessments: (1) items had low (<0.5) and nonsignificant cross-loadings, (2) the diagonal elements representing the square root of average variance extracted ($\sqrt{\rho_{vc}}$) exceeded the off-diagonal elements in Table 3, and (3) the ratio of the variance in the indicators for each construct relative to the total amount of variance exceeded 0.5 (Chin 1998). Discriminant validity was further confirmed by eigenvalues exceeding unity (range: 9.12 to 2.08), variance explained by individual factors (range: 11.83% to 6.06%), and low cross-loadings in principal components-based factor analysis.

4.1.1. Descriptive Statistics. The responding firms had an average revenue of \$82.1 million (SD \$212.8 million; range \$1.3 million to \$1.44 billion) and employed 495 individuals (SD 748). The projects represented a variety of applications. The projects and ranged from somewhat strategic to operational applications. Representative projects include systems for sales lead management, financial workflow management, a client database, transcription management, and auditing. The average duration of the projects was 6.3 months (SD 4.9 months); average team size 6 (SD 5); on average, the IT unit had completed 25 projects for the client department (SD 41). On average,

Table 3 **Construct Correlations and Distributions**

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Client technical knowledge	2.42	1.28	**0.82**														
2. IT bus. app. dom. knowledge	5.38	1.18	0.030	**0.85**													
3. DCR decentralization	3.76	1.45	0.230*	−0.059	**0.81**												
4. DMR centralization	4.36	1.36	−0.158	0.157	−0.102	**0.87**											
5. DCR exercise effectiveness	4.75	1.31	0.303**	0.261*	0.171	0.029	**0.85**										
6. DMR exercise effectiveness	5.15	0.86	0.044	0.396**	−0.007	0.082	0.268*	**0.79**									
7. Interdepartmental ties	5.19	1.36	0.306**	0.294**	0.135	−0.022	0.481**	0.268*	**0.89**								
8. Use of outcome controls	4.94	1.47	0.177	0.146	0.237*	−0.008	0.475**	0.218*	0.475**	—							
9. Use of behavior controls	4.29	1.67	0.273**	0.137	0.000	−0.008	0.406**	0.211*	0.388**	0.280**	—						
10. Interdepartmental interdependence	5.21	1.29	0.198	−0.203	0.279**	−0.314**	−0.190	−0.245*	−0.021	−0.051	−0.135	—					
11. Requirements specificity	4.06	1.43	−0.228*	−0.227*	0.244*	0.043	−0.289**	−0.207	−0.232*	−0.112	−0.180	0.023	**0.72**				
12. Project size	40.05	61.29	−0.048	−0.097	−0.082	0.007	−0.067	−0.080	0.024	−0.088	0.037	0.096	−0.016	—			
13. History	25.03	34.76	−0.123	0.243*	−0.178	−0.021	−0.195	0.079	0.083	−0.047	0.003	−0.079	−0.124	−0.049	—		
14. ISD *in*efficiency (% deviation)	16.51	43.37	−0.046	−0.101	0.044	0.079	−0.249*	−0.085	−0.255*	−0.265*	0.071	0.204	0.145	0.104	−0.063	**0.88**	
15. ISD effectiveness	6.16	0.78	0.108	0.408**	0.123	−0.090	0.225*	0.357**	0.268*	0.322**	−0.093	−0.033	−0.049	−0.049	0.135	−0.244*	**0.81**

Notes. Bold diagonals represent the square root of average variance extracted for multi-item scales.
$^{*}p < 0.05$ 1-tailed test; $^{**}p < 0.01$ 1-tailed test.

the projects exceeded their planned budget by 10.2% (SD 46.18%), schedule by 23.4% (SD 58.9%), and effort by 15.9% (SD 50.7%).

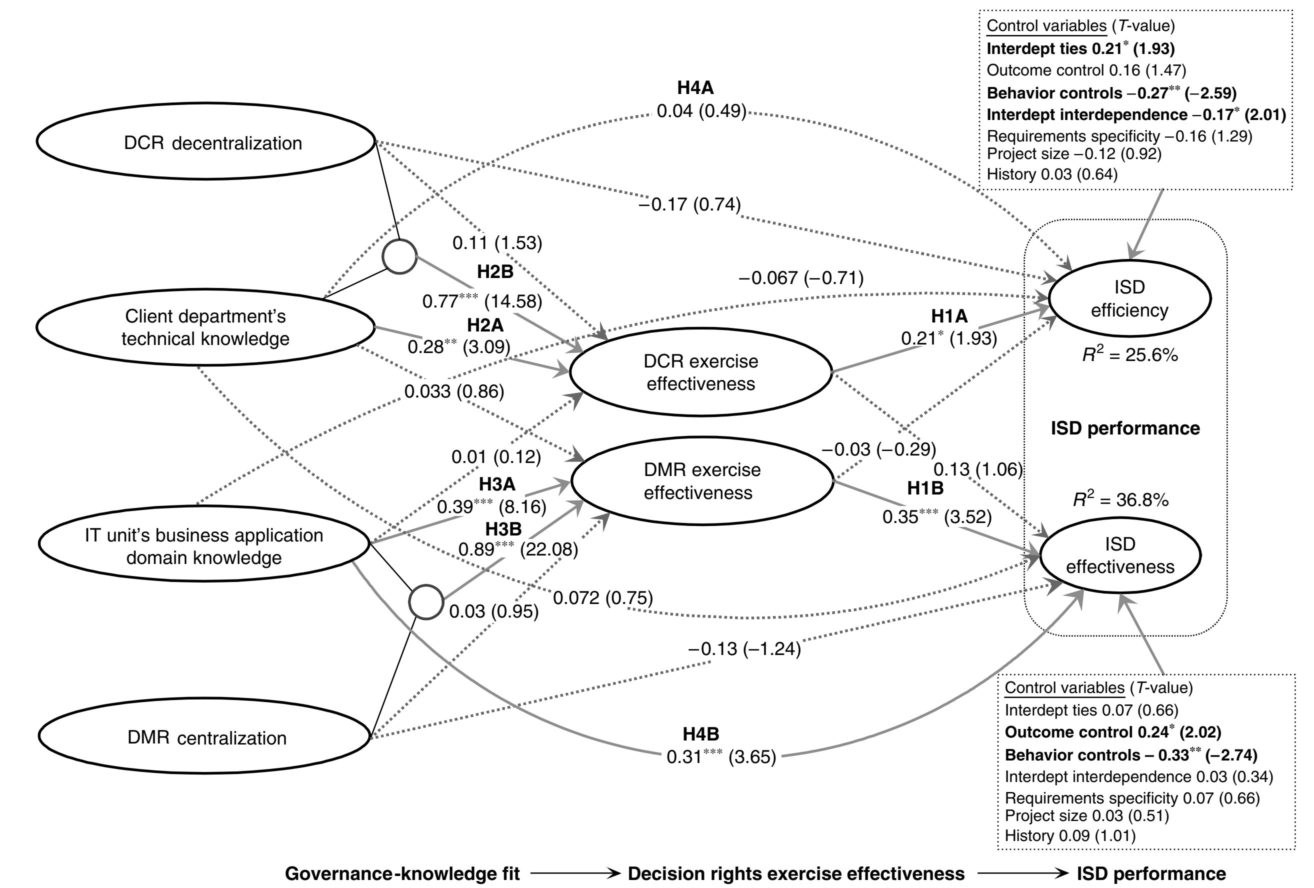
4.2. Structural Model Assessment

A bootstrapping procedure with replacement using 200 subsamples was used to estimate the statistical significance of the parameter estimates (summarized in Figure 2).

DCR exercise effectiveness had a significant positive effect on ISD efficiency at the project level ($\beta = 0.21$, T-value $= 1.93$, $p < 0.05$), supporting Hypothesis 1A. DMR exercise effectiveness had a significant positive effect on ISD effectiveness ($\beta = 0.35$, T-value $= 3.52$, $p < 0.001$), supporting Hypothesis 1B. The client department's technical knowledge had a significant positive effect on DCR exercise effectiveness ($\beta = 0.28$, T-value $= 3.09$, $p < 0.01$), supporting Hypothesis 2A. The IT unit's application domain knowledge had a significant positive effect on DMR exercise effectiveness ($\beta = 0.39$, T-value $=$ 8.16, $p < 0.001$), supporting Hypothesis 3A. Following Venkatraman's (1989) guidelines to ensure correspondence between theory and tests for fit, the two governance-knowledge fit hypotheses were assessed using moderation analysis in the structural model by creating two mean-centered interaction terms. The interaction between DCR decentralization and the client department's technical knowledge had a significant positive effect on DCR exercise effectiveness ($\beta = 0.77$, T-value $= 14.58$, $p < 0.001$), supporting the moderation Hypothesis 2B. The effect size f^2 from the addition of this interaction term was 0.69, suggesting that it explained significant additional variance beyond the main effects. The interaction between DMR centralization and the IT unit's business application domain knowledge had a significant positive effect on DMR exercise effectiveness ($\beta = 0.89$, T-value $= 22.08$, $p < 0.001$), supporting the moderation Hypothesis 3B. The effect size f^2 from the addition of this interaction term was 0.82. Figures 3(a) and 3(b) illustrate these interactions.

Hypothesis 4A and 4B proposed full mediation of the effects of knowledge on ISD performance by the effectiveness of exercising the associated project decision rights. Support for mediation requires that the mediator have a significant relationship with the independent as well as dependent variables. The absence

Figure 2 **Results**



Notes. ○ represent interaction terms; bold paths are significant; - - - dotted paths are nonsignificant. The numbers in the path model represent (*T*-value). Significant control variables are shown in bold.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

of a significant direct effect in addition to these relationships indicates full mediation, and its presence indicates partial mediation. The mediation effects proposed in both Hypothesis 4A and 4B were significant (see Figure 2). The direct effect from client departments' technical knowledge to ISD efficiency was nonsignificant ($\beta = 0.04$, T-value $= 0.49$) and the mediated paths were significant (i.e., Hypotheses 2A and 1A), suggesting that the relationship was fully mediated by DCR exercise effectiveness. Thus, Hypothesis 4A was fully supported. The direct effect from IT unit business application domain knowledge to ISD effectiveness was significant ($\beta = 0.31$, T-value $= 3.65$, $p < 0.001$) as were the mediated paths (i.e., Hypotheses 3A and 1B), suggesting that the relationship was partially mediated by DCR exercise effectiveness. Thus, Hypothesis 4B was not supported.

4.2.1. Assessment of Rival Explanations. Seven control variables were used to account for rival explanations of ISD performance. Use of outcome and behavior controls outcome and behavior controls, which impose accountability for project deliverables and processes (Kirsch 1996, Kirsch et al. 2002), can influence ISD performance. Close *interdepartmental ties* allow the IT unit to refine its understanding of client department needs (Reich and Benbasat 2000). However, greater *interdepartmental interdependence* increases the reliance of the IT unit on the client department (Adler 1995, Jensen and Meckling 1992), potentially lowering ISD performance. Similarly, higher project requirements *specificity* (Anand

Figure 3(a) **Interaction Effects for High (+2 SD) and Low (−2 SD) Values of Client Technical Knowledge**

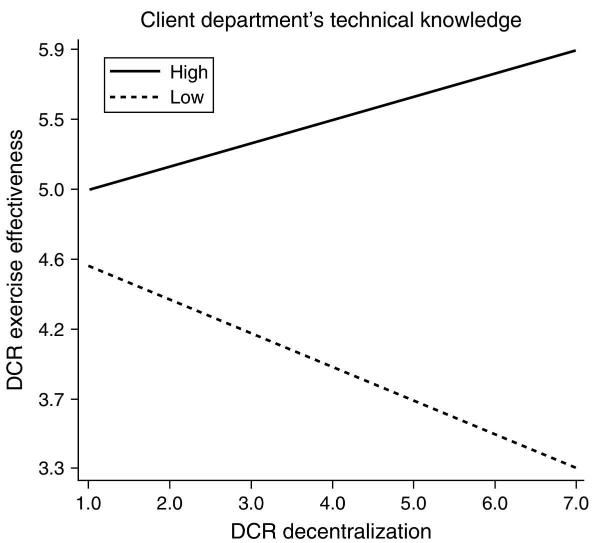
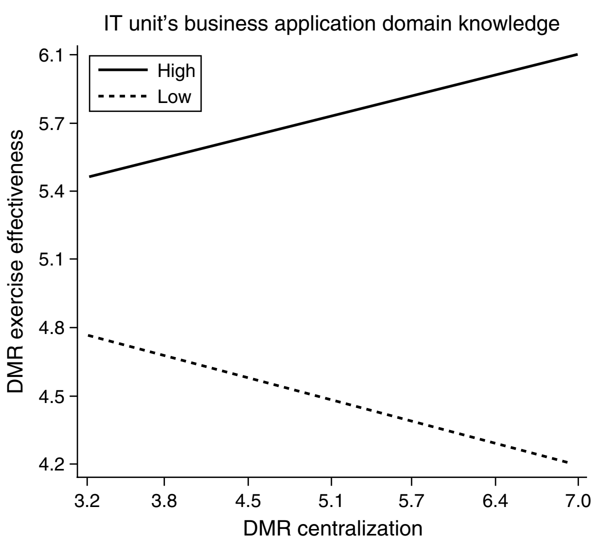


Figure 3(b) **Interaction Effects for High (+2 SD) and Low (−2 SD) Values of the IT Unit's Business Application Domain Knowledge**



and Mendelson 1997, Jensen and Meckling 1992), can impede communication of project requirements to the IT unit. (Specific knowledge is costly to transfer among specialized departments (Jensen and Meckling 1992); the sample mean of 4.06 for requirements specificity in the sample suggests that it was above average.) Project size (person-months) and collaborative history (number of projects previously completed by the IS unit for the client department) were also included as controls. Figure 2 shows that five of the seven controls were significant for at least one dimension of ISD performance. This pattern of results is not surprising since because many of them, while mentioned in the IS literature, have not previously been established to predict ISD performance. The model explained 25.6% of the variance in ISD efficiency and 36.8% of the variance in ISD effectiveness. The control variables explained 19.2% and 23% of this variance. These R^2 values suggest that the model explains variance in ISD performance beyond the extant literature.

4.3. Common Methods Bias Assessment

Four types of statistical analyses were conducted to assess the threat of common methods bias: (a) Harman's one-factor test (Podsakoff et al. 2003), and (b) Lindell and Whitney's (2001) marker variable test, (c) assessment of inter rater agreement on ISD efficiency and effectiveness for the matched-pair subset of the data, and (d) tests of differences among projects with and without matched pair responses. In Harman's one-factor test, the emergence of a single factor that accounts for a large proportion of the variance in factor analysis suggests a common methods bias (Podsakoff et al. 2003). No such single factor emerged and the first factor accounted for 11.8% of the total 73.6% variance. Second, the Lindell-Whitney (2001) marker variable test uses a theoretically unrelated (*marker*) variable to adjust the correlations among the model's principal constructs. Because a marker variable does not have a theoretically expected relationship with the study's principal constructs, a high correlation would indicate common methods bias (Malhotra et al. 2006). For robustness, the test was separately repeated with two otherwise unused variables for which there exists little theoretical basis for a relationship (project technical newness and public firm dummy). The average correlation of the study's principal constructs with technical newness ($r = 0.084$, $T = 0.696$) and with the public firm dummy ($r = 0.166$, $T = 0.970$) was low and nonsignificant, providing no evidence of common methods bias. Third, inter-rater agreement was assessed between IS and client respondents for the 37 projects with matched pair data. The matched pair sample was too small to retest the structural model but large enough to assess inter-rater agreement regarding about ISD performance. The first test was Shrout and Fleiss' (1979) intraclass coefficient (ICC), which measures consistency in the responses of IT and line managers. The ICC value for ISD effectiveness was 0.709 ($F = 3.43$, $p < 0.001$), indicating strong inter-rater agreement. A similar measure could not be computed using the three items for ISD efficiency because it was measured using three percentage deviation items for IT unit respondents but as perceptual items for client managers; the correlations between their ISD efficiency assessments were estimated in a PLS measurement model. These were significant for both ISD efficiency ($r = 0.391$, T-value 2.86; $p < 0.01$) and ISD effectiveness ($r = 0.583$, T-value 4.06; $p < 0.001$), suggesting significant inter-rater agreement. The moderate but significant correlation for ISD efficiency is consistent with previously-documented differences between IT and end-user perceptions (Keil et al. 2002). Fourth, T-tests revealed no significant differences in the principal constructs among projects that did and did not provide a matched pair response (IT unit business domain knowledge, $T = 0.45$; client technical knowledge, $T = 0.68$; DMR centralization, $T = 0.93$; DCR decentralization, $T = 1.25$; DCR exercise effectiveness, $T = 0.01$; DMR exercise effectiveness, $T = 0.26$; all nonsignificant). Furthermore, a recent meta analysis of over more than 200 empirical IS studies found that common methods bias because of the use of one dominant informant does not severely bias the results, as has previously been assumed (Malhotra et al. 2006). These four tests still leave open the possibility of informant bias, which is taken into account in interpreting the results.

5. Discussion and Conclusions

The motivation behind this study was to better understand how ex ante fit between project governance configurations and IT/client departments' knowledge influences ISD performance. This study developed and tested a middle-range theory (Van de Ven 2007, p. 142) that governance-knowledge fit enhances ISD performance by facilitating the effective exercise of project decision rights during the ISD process. It also showed how ISD efficiency and effectiveness are influenced by different classes of project decision rights. This is a significant departure from prior research, which has focused on either IT governance using the IT function as the unit of analysis or on project controls selection. The conceptualization of governance configurations using two classes of interdepartmentally-shared project decision rights better reflects contemporary ISD practice than does the received perspective. (The traditional departmental specialization-based model assumes that a client department defines project requirements and sets parameters such as budget, schedule, and project expectations, and that the IT department has considerable leeway in how it implements a system to fulfill those needs.)

The overarching contribution of the study is to an emerging research stream on IT project governance (e.g., Henry 2004, Mähring 2002, Tiwana and Keil 2007), to which it contributes an original theoretical explanation for how project-level governance-knowledge fit influences ISD performance. Collectively, these findings complement the extant IT-function governance (Brown 1997, Sambamurthy and Zmud 1999) and IS project control literature (Kirsch 1996, 1997).

5.1. Contributions

The first contribution of this study is conceptualizing how ISD efficiency and effectiveness are influenced by the effective *exercise* of two *different* classes of project decision rights. The results show that the effective exercise of: (a) DCRs enhances ISD efficiency but not effectiveness (Hypothesis 1A) and (b) DMRs enhances ISD effectiveness but not efficiency (Hypothesis 1B). Although Henderson and Lee (1992) have demonstrated that greater formal control leads to higher ISD performance, the separation of the antecedents of ISD efficiency and effectiveness is a relatively more distinctive finding that complements their work and that of Kirsch and her colleagues on the choice of project control portfolios.

The second contribution is showing that the client department's technical knowledge enhances DCR (but not DMR) exercise effectiveness (Hypothesis 2A) and the IT unit's business application domain knowledge influences DMR (but not DCR) exercise effectiveness (Hypothesis 3A). Although the need for technical knowledge in line functions has previously been recognized (Kirsch and Beath 1996, Nelson and Cooprider 1996, Reich and Benbasat 2000), less attention has been paid to the need for business knowledge in IT departments. These findings therefore complement at the project level prior findings that IT-line departments' shared knowledge improves overall IT unit performance (Nelson and Cooprider 1996) and IT alignment (Reich and Benbasat 2000).

The third contribution is the conceptualization of how project governance-knowledge fit influences the effective exercise of project decision rights. The paper is among the earliest to explicate the tensions between knowledge and agency theoretic considerations in interdepartmental partitioning of decision rights in systems development projects. The results show that decentralization of project DCRs strengthens the effect of the client department's technical knowledge on DMR exercise effectiveness (Hypothesis 2B). Similarly, centralization of project DMRs strengthens the effect of the IT unit's business application domain knowledge on DCR exercise effectiveness (Hypothesis 3B). Thus, the former type of governance-knowledge fit influences DCR exercise and the latter influences DMR exercise. These findings complement the emphasis on client technical knowledge in the controls literature (Kirsch et al. 2002, Tiwana and Keil 2007), to which they contribute a distinctive, finer-grained perspective in which interdepartmental governance-knowledge fit influences decision rights exercise.[1] The conceptualization of the two classes of project decision rights and their exercise effectiveness during the ISD process therefore represent original theoretical ideas that complement Kirsch and her colleagues' work based on agency and control theory.

The fourth contribution lies in theoretically developing an explanation for *how* IT-client department knowledge overlaps translate into ISD performance at the project level, i.e., the mediating role of exercise effectiveness for the two classes of project decision rights. The influence of the client department's technical knowledge on ISD efficiency was *fully* mediated by DCR exercise effectiveness (Hypothesis 4A), suggesting that such knowledge improves ISD performance primarily because it facilitates effective exercise of DCRs. The effect of the IT unit's business application domain knowledge on ISD effectiveness was partially mediated by DMR exercise effectiveness (Hypothesis 4B). The smaller direct effect suggests that the IT unit's business application domain knowledge can enhance ISD effectiveness in other ways besides enhancing DMR exercise. For example, an IT unit with higher business application domain knowledge might be better able to exercise self control and more easily interpret client department needs. These mediation findings complement prior studies on IT-line departments' shared knowledge (Nelson and Cooprider 1996, Reich and Benbasat 2000) by adding a hitherto-missing theoretical explanation for *how* business knowledge in the IT unit and technical knowledge in the client department enhances ISD performance. Furthermore, neither centralization nor decentralization of either class of project decision rights directly influenced their exercise effectiveness, suggesting that the location of decision rights by itself does not facilitate the effective accomplishment of the associated project activities. The new IT project decision rights scales developed here also lay the groundwork for future empirical work.

5.2. Limitations

Four limitations of the study should be considered. First, the study used IT unit informants to assess their business application domain knowledge and their client's technical knowledge. Since there is a realistic possibility that they might overestimate the former and underestimate the latter, the results should be interpreted with caution.

Second, the DCR effectiveness measure assumed that client departments had the greater responsibility for exercising DCRs. (No such assumption was made in the DMR exercise effectiveness measures.) This assumption fails to fully account for self control through which IT departments also share some of this responsibility. This assumption does not severely

[1] A comparison of the path coefficients of the two knowledge variables in Figure 2 tentatively suggests that the IT unit's business application domain knowledge outweighs the importance of the client department's technical knowledge. Caution is warranted in drawing this conclusion because a respondent-induced bias cannot be ruled out (i.e., the IT unit respondent could have self rated her department's business knowledge as being higher and the client department's technical knowledge as being lower). Furthermore, the means and standard deviations of DCR decentralization (3.76; SD 1.45) and DMR centralization (4.36; SD 1.36) reveals that they are close to the midpoint. This suggests that there might be more interdepartmental sharing of both classes of project decision rights between IT and client departments than assumed in prior research.

threaten the findings because self control has been found to be used only to a limited degree, and its relationship with performance remains empirically untested. However, caution is warranted in asserting that the client department exercised DCRs because the average value of DCR decentralization is 3.76, which suggests that they are close to the midpoint of the scale but skewed slightly towards IT. It is plausible that this skewing arises from the use of IS directors as the primary informants.

Third, the model explained 13.8% of the variance in ISD effectiveness but only 6.4% in ISD efficiency (i.e., <10%) beyond the controls, although these ΔR^2 values were significant. The smaller ΔR^2 for ISD efficiency therefore should be viewed as a limitation of the study.

Fourth, projects in the study were relatively small (40 person-months, on average). This might partially account for why both classes of decision rights in the sample leaned slightly towards IT. Although the most visible IT project failures studies have focused on large, mega projects, the majority of the routine development work in organizations encompasses smaller projects. To assess whether project size systematically biased the results, post hoc tests were conducted to assess whether project size was significantly related either to decision rights de/centralization or to ISD performance. Project size did not have a significant relationship with DCR decentralization ($\beta = -0.097$, T-value $= -0.792$, ns), DMR centralization ($\beta = -0.001$, T-value $= -0.011$, ns), ISD efficiency ($\beta = -0.134$, T-value $= -1.072$, ns), or ISD effectiveness ($\beta = -0.021$, T-value $= -0.170$, ns). This suggests that the smaller projects that characterized the data do not systematically bias the results.

5.3. Implications for Practice

These findings have three important implications for practice. First, managers must recognize whether project efficiency (budget and schedule compliance) or effectiveness (e.g., a mission critical or innovative application) is the cardinal imperative designing the governance configuration for a particular project, given that *different* classes of project decision rights influence them. For example, Hewlett Packard's recent enterprise system project failed when managers mistakenly planned around development efficiency instead of the actual imperative of effectiveness (*CIO Magazine* 2007). Second, interdepartmental sharing of project responsibilities requires both departments to maintain shared knowledge of each other's domain, a subtlety that is not fully appreciated in practice (e.g., Lohmeyer et al. 2002). Although maintaining such "peripheral knowledge" (Tiwana and Keil 2007) might appear challenging for both IT and line managers, end-user involvement in IT projects and IT staff involvement in business initiatives frequently presents opportunities for nurturing it. Third, assigning project decision rights to one department over the other enhances neither systems development efficiency nor effectiveness unless the associated department also has the pertinent complementary knowledge in the other department's domain. An illustrative example is the Denver airport baggage system (Keil and Montealegre 2000), where the IT groups were granted almost complete authority over design decisions, resulting in dismal outcomes.

5.4. Directions for Future Research

Future research can extend these findings in four promising directions. First, future work should explore the dynamics or temporal departmental migration of project decision rights across different project stages (e.g., design, coding, and testing). Such work could directly build on Kirsch's (2004) study on the dynamics of control mechanisms. It might also be fruitful to theorize how the interactions between IT-client knowledge and the chosen project control mechanisms influence the location of the two classes of decisions rights. Second, how does governance-knowledge fit in internal projects differ from outsourced projects? Decision rights alienability discussed by Jensen-Meckling and the more pronounced incentive conflicts that characterize the latter represent promising starting points for theory development. Third, it would be useful to explore whether IT-client "relationship assets" (Ross et al. 1996) substitute for decision rights decentralization or the absence of IT-client knowledge overlaps. This could be examined following recent empirical studies of substitution conceptualized as negative interactions among model variables (Siggelkow 2002, Tiwana 2008). Finally, how should governance configurations be designed in the burgeoning context of IT services, which lack a clear endpoint like application development projects? Differences in the intrinsic characteristics of IT applications and IT services (e.g., Rai and Sambamurthy 2006) could provide a rich basis for theory development.

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Appendix. Measures
The IT unit was asked to identify one major internal IT project that it had recently completed. The IT unit was defined as the responding organization's MIS department and the client department was defined as the business unit or department (such as sales, purchasing, manufacturing, human resources, accounting, and finance) of the organization for which the project was *primarily* undertaken. All multi-item scales used 7-point measures.

Decision management rights (*DMR*) *centralization* ($\alpha = 0.85$; respondent: MIS director) was measured using seven items that assessed the extent to which the *IS unit* was primarily responsible for decisions regarding about the following for the project: (1) systems design, (2) system architecture, (3) the software platform, (4) development methodology, (5) programming language, (6) system features, (7) key project concepts (dropped), and (8) system functionality. The scale anchors were *primarily the client department* on the low end, *primarily the IT unit* on the high end, and *equally shared between the IT unit and the client department* at the midpoint.

Decision control rights (*DCR*) *decentralization* ($\alpha = 0.91$; respondent: MIS director) was measured using three items that assessed the extent to which the *client department* was primarily responsible for decisions regarding about the following for the project: (1) establishing project outcome rewards and penalties, (2) monitoring project progress, and (3) approving intermediate prototypes. The following items were dropped in the scale refinement process: establishing project success criteria, budget, schedule, project deliverables, and milestones. The scale anchors were *primarily the client department* on the high end of the scale, *primarily the IT unit* on the low end, and *equally shared between the IT unit and the client department* at the midpoint.

Client department's technical knowledge ($\alpha = 0.906$; respondent: MIS director) was measured using six items that assessed the extent to which the client department understood the following specific to the named project: (1) technical constraints, (2) system architecture, (3) programming language, (4) detailed technical design, (5) code testing and debugging procedures, and (6) application development tools. The anchors were *not at all* and *to a great extent*.

IT unit's business application domain knowledge ($\alpha = 0.921$; respondent: MIS director) was measured using six items that assessed the extent to which the IT unit understood the following about the client department specific to the this project: (1) business rules implemented in this system, (2) business processes, (3) day-to-day business routines, (4) business strategy, (5) a "big picture" of the client department, and (6) a holistic understanding of the client department's activities. The anchors were *not at all* and *to a great extent*.

Requirements specificity ($\alpha = 0.816$; respondent: MIS director) was measured using an adapted version of Hansen's (2002) four-item noncodification scale. The four items assessed the IT unit's agreement with the following statements: (1) initial formal project requirements captured the client department's needs very poorly; (2) knowledge that we leveraged from the client department was very poorly documented; (3) this knowledge was primarily informal rather than formal (e.g., documents, reports, manuals); and (4) none of this knowledge was sufficiently explained to the IS unit in writing (e.g., in code comments, written reports, manuals, emails, or formal requirements).

DCR exercise effectiveness ($\alpha = 0.90$; respondent: MIS director) was measured using five items that measured the IT unit's assessment of the extent to which the client department had: (1) provided an appropriate budget, (2) set a reasonable schedule, (3) set reasonable expectations, (4) established clear milestones, and (5) set clear deliverables for the project. Anchors: *strongly disagree* and *strongly agree*.

DMR exercise effectiveness ($\alpha = 0.874$; respondent: MIS director) was measured using six items on a Likert scale that assessed the following compared to other projects that the respondent was familiar with: (1) appropriateness of the system design, (2) appropriateness of the system architecture, (3) appropriateness of the software platform, (4) appropriateness of the development methodology, (5) appropriateness of the programming language, and (6) appropriateness of the implemented features. The anchors were *strongly disagree* and *strongly agree*.

ISD efficiency ($\alpha = 0.84$ (MIS director) and 0.75 (client department manager); respondents: both MIS director and client department manager) was measured in terms of percentage overrun (or under-run) relative to the originally planned level in the project's budget, schedule, and development and programming effort for the IT respondent. This percentage deviation measures *in*efficiency, requiring the construct sign to be reversed to capture ISD efficiency. The client respondent provided an assessment of the project on these three facets of efficiency using a seven-point Likert scale with the following anchors: *much worse, as planned*, and *much better*. This approach was used because the client managers might not have access to precise information about overruns or overruns as percentages of the originally planned level of programming effort.

ISD effectiveness ($\alpha = 0.89$ (MIS director) and 0.91 (client department manager); respondents: both MIS director and client department manager) was measured using a six-item semantic differential scale. The anchors were: (1) unsuccessful/successful, (2) not valuable to client department/valuable to client department, (3) inappropriate/appropriate, (4) worthless/worthwhile, (5) misfit with business objectives/strong fit with business objectives, and (6) disconnected from business needs/fulfills business needs.

Interdepartmental interdependence (respondent: MIS director) was measured using a Guttmann scale adapted from Sethi (2000) that assessed the level of integration of activities between the IT unit and client department that was ideally necessary over the project's life cycle for the project to succeed. The anchors were: (1) very low (little beyond requirements), (2) low, (3) somewhat low, (4) moderate (some integration was needed), (5) somewhat high, (6) high, and (7) very high (substantial integration was needed throughout the project life cycle).

Use of formal control mechanisms. O*utcome control* was measured using the MIS director's assessment of the degree to which the client department evaluated the IT unit for this project *primarily* based on accomplishing project goals on time and within budget. The item was adapted from Kirsch et al. (2002). *Behavior control* was measured using the IT unit's assessment of the degree to which the client department expected the IT unit to follow a prescribed process to ensure that the delivered system met their its requirements. The scale item was adapted from Kirsch et al. (2002). We used coarse, single item measures for these because our objective was simply to control for their use and because of space constraints.

Interdepartmental ties ($\alpha = 0.86$; respondent: MIS director) was measured using Hansen's (2002) three-item, 7-point, semantic differential scale. The items tapped into the frequency of interactions, close working relationships, and frequent communications between the IT unit and client department over the course of the project. The anchors were *strongly disagree* and *strongly agree*.

Project size was measured in person-months, using project duration (the scheduled number of months for the project) $*$ project team size (the number of individuals working on the project full time).

Client department-IT unit history was measured as the number of projects previously completed by the IT unit for the client department.

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