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RESEARCH ARTICLE

Enhancing client controls and information systems development project outcomes: Roles of team collaborative culture and coordination technology

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Abstract

Effective client controls, both behavioral and outcome based, are essential to the success of Information Systems Development (ISD) projects, yet the role of project team collaborative culture and coordination technology in enabling these controls remains insufficiently examined. We propose and test a research model about these relationships using structural equation modeling with survey responses from 218 ISD projects. The results show that collaborative culture and coordination technology both significantly increase clients' use of behavior and outcome controls. In turn, these controls are positively associated with project outcomes, underscoring the importance of aligning project culture and tools with management practices. Our findings contribute to the IS project management literature by highlighting how fostering a collaborative culture and leveraging coordination technology can lead to more successful project outcomes. This study provides practical guidance for ISD practitioners by demonstrating how collaborative culture and coordination technology can be leveraged alongside client behavioral and outcome controls to reduce coordination costs, manage task dependencies, and improve project assessment and adaptive management for enhanced project success.

1. Introduction

Information Systems Development (ISD) projects have become increasingly complex, involving extensive project planning, process design, requirements determination, and logical and physical system designs (Iivari, 2021; Ko et al., 2019). These projects often span multiple organizations and require close interactions between clients and vendors, making collaboration a critical success factor (Dieterich & Ohlhausen, 2023). However, effective collaboration in ISD environments is challenging due to differing interests, cultural mismatches, and communication barriers between clients and vendors (Ahmed et al., 2025; Xia et al., 2024).

A growing body of research highlights the significance of a collaborative culture in ensuring the success of ISD projects (Dieterich & Ohlhausen, 2023; Gupta et al., 2019; Narayanaswamy & Henry, 2005). Collaborative culture encompasses shared values and norms that encourage trust, mutual respect, and transparent communication among stakeholders (Bendoly et al., 2012; Cameron & Quinn, 2005). It facilitates open decision-making and aids project teams in navigating unexpected challenges (Ko et al., 2019). This cultural alignment between vendors and clients is especially valuable when uncertainty and ambiguity emerge (Dieterich & Ohlhausen, 2023; Mao et al., 2008). Lacking a collaborative culture can obstruct alignment and create barriers to project success.

To reduce collaboration complexity and support joint work across boundaries, ISD vendors have increasingly adopted coordination technologies such as workflow systems, collaboration platforms, and communication tools (Bala et al., 2017; Behn & Silvius, 2025; Mentzas, 1993) to reduce collaboration complexity and support joint work across boundaries. These technologies facilitate timely information exchange and tracking, allowing clients to monitor project progress, provide input, and maintain alignment with business objectives. Coordination integrates and aligns individual efforts toward a shared goal (Hoegl & Gemuenden, 2001; Singh, 1989). In ISD projects, coordination technologies enable and support the project's shared task-related goal structure, helping to synchronize activities across clients, vendors, and users (Bala et al., 2017; Mentzas, 1993). Despite their growing importance, the role of coordination technologies in enabling new strategic processes and ensuring project success remains an emerging area of research (Bala et al., 2017; Sarma, 2019).

Coordination technologies enhance controls such as contract monitoring, scope enforcement, and milestone tracking (Ditmore, 2019; Ko et al., 2019). They are particularly relevant in ISD outsourcing contexts, where vendor accountability and project transparency are critical to success. In addition to supporting contract monitoring and milestone tracking, coordination technologies enable clients to access real-time project information and communicate directly with development teams (Bala et al., 2017; Kuciapski & Marcinkowski, 2023). For example, digital communication tools such as videoconferencing and asynchronous messaging help facilitate remote meetings, streamline information exchange, and maintain clear records of project progress and team decisions (Swart et al., 2022). As ISD outsourcing becomes more prevalent, the limitations of contract-based controls have become increasingly evident due to project uncertainty and scope variability (Ditmore, 2019; Ko et al., 2019). Project requirements continuously evolve during the development process, often emergent, making it difficult for rigid contracts to accommodate unanticipated changes and uncertainty (Xia et al., 2024). By leveraging coordination technologies, clients can strengthen their controls by leveraging coordination technologies while facilitating effective collaboration with ISD vendors. These technologies enhance transparency, streamline communication, and support the coordination of project activities, making them particularly valuable in outsourced ISD environments (Kuciapski & Marcinkowski, 2023; Xia et al., 2024). They also help reinforce shared expectations and facilitate the monitoring of project commitments (Behn & Silvius, 2025).

While collaborative culture and coordination technology have been recognized as essential ISD projects, their influences on clients' controls and project success remain underexplored (Das & Teng, 2001; Dieterich & Ohlhausen, 2023; Iivari, 2021; Sundaramurthy & Lewis, 2003). Prior research has rarely examined how collaborative culture influences client controls. Most IS studies focus on control types, such as behavior and outcome (Choudhury & Sabherwal, 2003; Kirsch, 1997), overlooking the role of collaborative culture. The relationship between collaborative culture and client controls has

yet to be integrated into ISD control literature (Gopal & Gosain, 2010; Gregory et al., 2013; Maruping et al., 2019). Empirical evidence linking collaborative culture to client control remains limited and warrants further investigation (Dieterich & Ohlhausen, 2023; Iivari, 2021). Moreover, while some studies have highlighted coordination technologies' role in enabling clients to monitor progress, assess performance, and regulate vendor activities (Bala et al., 2017; Im & Rai, 2014; Mao et al., 2008), few have explicitly examined how these technologies affect clients' controls and ISD project success (Faraj & Xiao, 2006; Germonprez et al., 2007). These gaps are further underscored by recent work on paradoxical tensions in project management, highlighting a persistent gap in addressing the complex and often contradictory dynamics in ISD environments, such as the need to balance control and collaboration (Dieterich & Ohlhausen, 2023; Iivari, 2021).

This study addresses these gaps by examining how collaborative culture and coordination technology influence clients' behavior, outcome controls, and ISD project outcomes. Specifically, we answer the following research questions: (1) How are the ISD project team's collaborative culture and coordination technology related to the client's behavior and outcome controls? (2) How are the client's behavior and outcome controls related to ISD project outcomes?

This study offers significant contributions to both the theoretical understanding and practical management of Information Systems Development (ISD) projects. On the theoretical side, it broadens the understanding of how a collaborative culture and coordination technology influence clients' behavior and outcome controls – areas that previous IS research has largely overlooked. The study achieves this by constructing and empirically testing a model that links the project context, control mechanisms, and project outcomes. This approach effectively bridges two previously disconnected research streams: project governance and collaborative practices. On the practical side, the findings provide actionable insights for ISD project managers. For instance, fostering a collaborative culture and adopting coordination technologies can strengthen client oversight, reduce coordination complexity, and enhance project performance. Taken together, these results offer a roadmap for balancing control and collaboration, a common challenge in outsourced ISD environments.

The remainder of this paper is structured as follows: Section 2 reviews relevant literature and theoretical frameworks. Section 3 outlines the research model and the hypotheses. Section 4 details the methodology used in the study. Section 5 presents the research results. Section 6 discusses the findings. Section 7 examines both the theoretical and practical implications of the research, as well as suggestions for future studies. Finally, conclusions are drawn in Section 8.

2. Literature review

As the conceptual foundation for our study, we review the literature related to our five core constructs: collaborative culture, coordination technology, client's behavior control, client's outcome control, and project outcomes.

2.1. Collaborative culture in ISD projects

A collaborative culture supports trust, open communication, and shared responsibility through shared values, norms, and beliefs. It helps teams make better decisions, communicate clearly, and build a common understanding (Cameron & Quinn, 2005; Gupta et al., 2019; Leidner & Kayworth, 2006; Narayanan et al., 2015). As ISD projects become more complex and involve multiple stakeholders, creating a culture that supports teamwork and innovation becomes more important (Gupta et al., 2019; Hoegl & Wagner, 2005; Mao et al., 2008). Aligning the project environment with external challenges and competitive demands can help improve project performance (Child, 1997; Sydow et al., 2009; Venkatraman, 1990). A strong collaborative culture helps teams respond to change, solve problems, and align vendor skills with clients' goals (Blazevic & Lievens, 2008; Ko et al., 2019; Leidner & Kayworth, 2006).

Moreover, culture shapes control preferences: in high-trust environments, clients may rely more on relational or outcome-oriented controls, while in low-trust or high-risk settings, behavior control may be emphasized (Das & Teng, 2001; Gregory et al., 2013; Maruping et al., 2019). A collaborative culture fosters trust between clients and vendors at the project team

level, enhancing client's outcomes and behavior control mechanisms (Doney et al., 1998; Mao et al., 2008). The cultural environment shapes how control is exercised in collaborative settings (Bahli & Rivard, 2003).

2.2. Coordination technology in ISD projects

Coordination technologies enable ISD project stakeholders to manage interdependent tasks, synchronize progress, and maintain alignment despite spatial, temporal, or organizational boundaries (Bala et al., 2017; Crowston et al., 2004; Sarma, 2019). These tools, such as project management systems, document-sharing platforms, and video conferencing applications, facilitate structured interactions through embedded protocols like milestone tracking and issue resolution (Crowston, 1997; Im & Rai, 2014; Mentzas, 1993). Interpersonal relationships and clear communication are critical for success (Jassawalla & Sashittal, 2003; Smolander et al., 2016). A lack of task progress information increases performance ambiguity and disrupts collaboration (Heide & Miner, 1992). Coordination theory highlights that unmanaged dependencies between tasks and resources can result in project delays or failure, and stresses the need for mutually agreed protocols to manage them effectively (Crowston, 1997; Crowston et al., 2004).

In an outsourced ISD context, coordination technologies are critical where contract-based governance falls short (Ko et al., 2019; Kuciapski & Marcinkowski, 2023). These tools provide real-time visibility into vendor activities, supporting proactive intervention and milestone verification (Bala et al., 2017; Mao et al., 2008). Beyond communication, these systems enhance project information processing and interpretation, allowing clients and vendors to align goals and adapt workflows (Bahli & Rivard, 2003; Im & Rai, 2014). Despite their widespread use, the role of coordination technologies in shaping client's control remains underexplored. Recent studies highlight the importance of coordination in improving ISD outcomes, but fail to explain its role in enabling client's control (Xia et al., 2024).

2.3. Client's behavior and outcome controls in ISD projects

Client's control refers to approaches used by the client to influence vendor behavior and ensure that project objectives are achieved (Ouchi, 1979; Rustagi et al., 2008). Two widely recognized types of control are behavior control and outcome control (Das & Teng, 2001; Ko et al., 2019). Behavior control involves monitoring compliance with predefined processes and procedures, while outcome control focuses on results and performance metrics (Mao et al., 2008; Stump & Heide, 1996).

Although client's controls are essential in ISD projects, there is limited understanding of how client use behavior and outcome controls when managing vendors, particularly in contexts shaped by collaborative culture and coordination technologies. While prior studies have examined control modes and styles at the individual level (Remus et al., 2016) and highlighted the importance of integrating control frameworks in project settings (van Fenema, 2002), few have focused on how collaborative culture and coordination technologies shape client's controls in ISD collaborations.

2.4. Project outcomes in ISD projects

Project outcomes are typically evaluated in terms of effectiveness (meeting functional and quality goals) and efficiency (adherence to timelines and budgets) (Hoegl & Wagner, 2005; Lee & Xia, 2010). A multidimensional perspective on project outcomes is increasingly endorsed to reflect the practical realities of IT project delivery, where technical, behavioral, and organizational factors influence success (Xia et al., 2024). Effectiveness often includes the degree to which system requirements are fulfilled and project deliverables align with user expectations, while efficiency measures relate to schedule adherence and cost control (Mao et al., 2008; Xia & Lee, 2003). These dimensions reflect the client's perception of value and are particularly relevant in outsourced ISD contexts, where accountability and delivery performance are shared across boundaries.

3. Research model and hypothesis development

This research investigates how collaborative culture and coordination technology influence the types of controls client use (behavior and outcome controls), and their effects on ISD project outcomes. Figure 1 illustrates the proposed research model, showing relationships among collaborative culture, coordination technology, client behavior and outcome controls, and project outcomes.
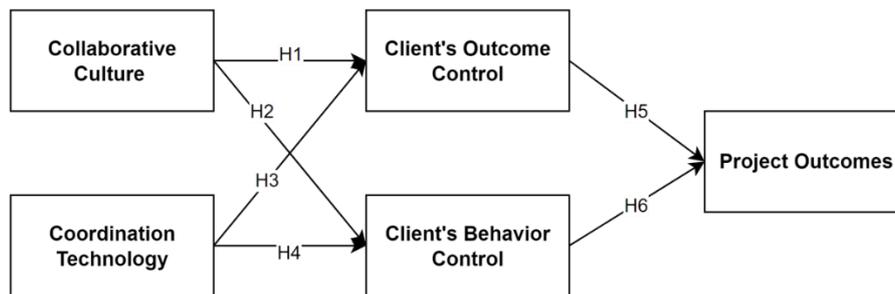

Fig. 1. Research Model

The ISD project's collaborative culture creates a team climate where the client and vendor teams can engage in effective, successful joint activities. Successful collaboration depends on mutual willingness and cannot be mandated. Instead, project management must cultivate a collaborative team culture to promote shared decision-making, joint problem-solving, trust, and respect (Dey et al., 2010; Gopal et al., 2003; Selnes & Sallis, 2003). Such a culture facilitates high morale, commitment, and alignment with strategic goals, which is particularly valuable in navigating project uncertainties (Cameron & Quinn, 2005; Gopal et al., 2003). Clients typically rely on two main types of controls to guide and motivate vendors: outcome controls, which focus on work results, and behavior controls, which dictate the processes by which work is performed (Jaworski, 1988; Kirsch, 1996).

According to Ko et al. (2019), client's outcome control emphasizes a client's control over specific desired task results. This approach focuses on setting clear targets and granting vendors autonomy to determine how to achieve those objectives (Ko et al., 2019). In a collaborative project, cultivating a collaborative culture through project management is essential to foster open communication, a sense of ownership among team members, and greater coordination and cooperation (Cameron & Quinn, 2005). This, in turn, increases the effectiveness of the client's outcome control by empowering shared decision-making and creating a collaborative environment that fosters collaboration and innovation. Client's outcome controls ensure that IS project teams align with budgets, schedules, and objectives, directing vendor teams toward successful outcomes (Ko et al., 2019). A collaborative culture will likely promote the client's outcome control by creating a collaborative environment that encourages joint activities and empowers shared decision-making. Therefore, we propose:

> H1: ISD project collaborative culture positively relates to the client's outcome control.

Collaborative culture supports client's behavior control by promoting transparent adherence to predefined procedures. It assesses, monitors, and regulates how the vendor team follows agreed-upon procedures. This clarity ensures that vendors' processes remain consistent, fostering a shared understanding of task procedures (Ko et al., 2019). Client's behavior control is likely more effective in an outsourced ISD project with a collaborative culture. A lack of collaborative culture may cause misunderstandings between clients and vendors (Gregory et al., 2013). Behavior control directs vendors by specifying steps and procedures, assessing their performance on adherence, and ensuring successful outcomes by

minimizing deviations from the team culture (Ko et al., 2019). As such, collaborative culture enhances the effectiveness of behavior control by fostering procedural transparency and consistency. Therefore, we propose:

H2: ISD project collaborative culture positively relates to the client's behavior control.

Coordination technology facilitates timely information sharing, synchronization of tasks, and transparent communication between clients and vendors. It enhances the client's capability to set clear objectives and effectively monitor project performance, reinforcing the client's outcome control (Bala et al., 2017). This can help the client regulate joint activities, strengthening the client's outcome control (Ko et al., 2019). Prior research indicates that product teams may need adequate task coordination to meet budget and schedule targets despite having sufficient information and regular communication with external members (Ancona & Caldwell, 1992).

Coordination technology enhances the information transparency between clients and vendors, which is crucial for establishing mutual goals and directions. Transparency fosters a positive reinforcing cycle where vendors, as controlled entities, align with client goals, reducing vulnerability and boosting confidence; this allows clients to minimize control, giving vendors greater freedom to innovate and collaborate, creating a conducive environment for creativity and effective resource use (Liu & Chua, 2020). Such shared objectives and information transparency between clients and vendors, enabled by coordination technologies, ultimately enhance clients' control over project outcomes (Bala et al., 2017). Therefore, we propose:

H3: ISD project coordination technology use positively relates to client's outcome control.

Coordination technologies also play a crucial role in supporting behavior control by enabling client to continuously monitor vendor adherence to established procedures and standards (Bala et al., 2017). Coordination technology is pivotal in streamlining activities within the development team and externally with clients, fostering clear communication, and facilitating interactions among multiple stakeholders (Ancona & Caldwell, 1992). However, vendor deliverables may not align with client expectations when misunderstandings occur, potentially impacting project timelines and quality. In response to those concerns, the client can intensify behavior control, emphasizing procedural efficiency and timely delivery, leading to more rigorous and frequent checks (Gregory et al., 2013). As such, coordination technology enhances clients' ability to manage vendor behaviors effectively (Mao et al., 2008). Therefore, we propose:

H4: ISD project coordination technology use positively relates to client's behavior control.

Client's outcome control, focusing on clear objectives and results, enables clients to evaluate vendor performance directly related to project success criteria and influence ISD project outcomes by ensuring alignment with project objectives, quality standards, schedules, and budgets (Ko et al., 2019; Mao et al., 2008). For example, client's outcome control helps ensure the project team achieves the desired goals. The client can hold the vendor team accountable for failing to accomplish the project objectives by emphasizing and evaluating the performance related to project goals and targets. Outcome control is essential to ensure that projects are completed on schedule, within the budget, and meet the required level of quality. Outcome control enables clients to monitor progress and assess task interdependencies, facilitating timely corrective actions and optimizing alignment with desired outcomes (Ko et al., 2019). Therefore, we propose:

H5: ISD project client outcome control positively relates to the project outcomes.

Behavior control supports project outcomes by enforcing consistency, standardization, and adherence to established processes. By tracking vendor compliance with procedures systematically, clients can quickly identify and address deviations, minimizing errors, rework, and schedule disruptions. By regulating how the vendor team follows agreed-upon procedures, the client can identify potential problems early and take corrective actions to avoid delays or cost overruns. When a client employs behavior control, it implies that the vendor should consistently share updates on their adherence to set procedures (Ko et al., 2019). Recognizing this possible control increase, vendors may need to adapt their approaches to enhance project effectiveness (Gregory et al., 2013). The client may have frequently employed daily status

reviews for closer monitoring (Gregory et al., 2013). This intensified behavior control approach may make the overall management more procedural. Client's behavior control promotes establishing a shared understanding of task procedures, enhances team coordination, and ensures adherence to project specifications (Ko et al., 2019). Therefore, we propose:

> H6: ISD project client's behavior control positively relates to project outcome.

4. Research methods

Our research method followed a four-stage process: (1) initial conceptual and item development, (2) refinement through pre- and pilot-testing, (3) large-scale data collection via surveys, and (4) data analysis, including measurement validation and structural model testing (Xia & Lee, 2003; Xia et al., 2024). In the first stage, we developed a conceptual framework based on a literature review to capture the key aspects of ISD project management. An initial pool of measurement items was generated, with established scales adapted from prior studies where appropriate.

We interviewed and used a Q-sorting procedure with six IT professionals in the second stage. These interviews provided critical insights into the contextual realities and challenges of ISD projects, helping to identify facets of the constructs not adequately captured by the initial survey items. The Q-sorting procedure was used to assess face validity and construct validity qualitatively (Gupta et al., 2019; Lee & Xia, 2002; Moore & Benbasat, 1991). We then did a pilot test with a sample of 66 participants drawn from the outsourcing companies involved in the earlier interviews. The pilot results confirmed that the items were clear, comprehensible, and representative of the targeted constructs, with acceptable reliability and validity (Presser et al., 2004). We then created a finalized version of the survey, incorporating improvements from the pilot test.

In the third stage, we created an online survey and distributed it for large-scale data collection. A seven-point Likert scale was used for all item measurements, and items were randomly ordered to mitigate potential method bias. Data were collected through a publicly accessible online survey platform, while paper-based forms were also made available for respondents who preferred offline participation. The final stage involved rigorous data screening, validation of measurements, and assessment of the structural model, wherein the researcher evaluated the validity and reliability of the measurement items and applied various statistical methods to test the structural model rigorously.

4.1. Data collection

This study used the snowball sampling technique to approach survey participants. During the pilot phase, senior managers from outsourcing companies who had previously expressed interest in supporting academic research were invited to participate. Each pilot test respondent received a $12 (USD) digital gift card as a participation incentive and was encouraged to share the survey link with colleagues. This effort yielded 66 valid responses. We then employed snowball sampling to expand the sample. The survey link was redistributed to the 66 initial respondents, who were encouraged to forward it within their professional networks. No incentives were offered during this stage. In addition, the survey was disseminated through LinkedIn, WeChat, and iMessage. We created a public-facing research website providing project background and participation details to facilitate access and transparency. Snowball sampling is beneficial for reaching dispersed or hard-to-access populations and has been widely used in social science and information systems research to facilitate network-based participation (Biernacki & Waldorf, 1981; Johnson, 2014; Noy, 2008).

4.2. Data screening and descriptive analysis

We excluded 68 responses with more than 20% missing values to improve data quality. The remaining responses were screened for unusual patterns or careless input; none were found. Descriptive statistics for the final sample are presented in Appendix A. Our final study sample included 218 valid responses representing 91 companies across more than eight industries. Participants were involved in ISD projects with clients in the U.S., Europe, China, Japan, and other countries. Project team sizes ranged from six to over 100. Respondents included IT engineers, data development engineers, test engineers, team leaders, and project managers, who were directly involved in cross-boundary coordination and decision-making in ISD projects.

4.3. Assessment of non-response and method biases

We recorded the response submission dates to assess non-response bias and divided them into early and late respondent groups. Independent-samples t-tests revealed no significant differences across key demographic variables, project attributes, or item-level responses, indicating that non-response bias is unlikely to be a concern. To assess common method bias, we performed Harman's one-factor test on all latent constructs as recommended by Malhotra and Podsakoff (Malhotra et al., 2006; Podsakoff & Organ, 1986). The most common covariance explained by one factor is only 34.0%, which is less than the 50% threshold recommended by (Podsakoff & Organ, 1986). Therefore, common method biases are unlikely to be a serious concern. We also assessed the minimum sample size requirement recommended by Barclay et al. (1995) and Cohen (1992). Our study met these requirements.

4.4. Measures and control variables

We operationalized the constructs by adapting existing scales to fit the context of our study. The final items for measuring the constructs are shown in Appendix B. All variables in the research model are assessed as first-order constructs. Collaborative Culture, Coordination Technology, and Project Outcomes were assessed as reflective constructs. In contrast, Client's Behavior Control and Outcome Control were assessed as formative constructs. Measures of collaborative culture were adopted from the Competing Values Framework (Cameron & Quinn, 2005; Quinn & Rohrbaugh, 1983). Measures of Coordination Technology were adapted from Bala et al. (2017) and Guinan et al. (1998). Behavior Control and Outcome Control were adapted from Kirsch et al (2002) and Lee and Xia (2010). Measures of Project Outcomes were adopted from Lee and Xia (2010). We also include two control variables in the analysis. First, we controlled for project duration, the number of days spent completing the project. Prior research suggests that IS projects with longer durations tend to be associated with decreased performance. Second, we controlled for project size because the increased project team size is associated with coordination difficulties and reduced performance.

4.5. Data analysis and results

Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS was employed to test our research hypotheses. PLS-SEM, which is widely utilized in the IS and business disciplines, was suitable for our data analysis due to its capability to manage complex models, non-normal data, small sample sizes, and the formative measurement of latent variables (Hair Jr et al., 2016; Shiau & Chau, 2016). PLS-SEM can analyze formative and reflective variables in complex research models, making it ideal for our research (Hair Jr et al., 2016; Lowry & Gaskin, 2014; Shiau & Chau, 2016).

5. Results

5.1. Measurement model assessment (reflective constructs)

A multivariate measurement approach was developed and implemented for the structural equation model to enhance the measurement accuracy and comprehensively represent the various facets of the concept. For variables using reflective measures, Collaborative Culture, Coordination Technology, and Project Outcomes variables, we assessed internal consistency reliability (using Cronbach's alpha and composite reliability), convergent validity (through outer loadings, average variance extracted (AVE)), and discriminant validity (Fornell-Larcher Criterion, heterotrait–monotrait (HTMT)) (Hair Jr et al., 2016). The assessment results are shown in Table 1. Measures for all three variables exhibited satisfactory reliability as indicated by Cronbach's Alpha and Composite Reliability greater than the recommended threshold of 0.70 (Chin, 1998). We then established convergent validity for all measures by the acceptable levels (>0.5) of outer loadings and average variance extracted (Hair Jr et al., 2016; Lowry & Gaskin, 2014).

Table 1. Convergent validity and reliability of reflective measures

Reflective Constructs	Indicators	Convergent Validity		Internal Consistency	
		Outer Loadings	Average Variance Extracted (AVE)	Cronbach's Alpha	Composite Reliability
Collaborative Culture (CC)	CC_1	0.834	0.735	0.880	0.917
	CC_2	0.884			
	CC_3	0.893			
	CC_4	0.816			
Coordination Technology (CT)	CT_1	0.825	0.722	0.872	0.912
	CT_2	0.860			
	CT_3	0.903			
	CT_4	0.808			
Project Outcome (PO)	PO_1	0.845	0.727	0.906	0.930
	PO_2	0.834			
	PO_3	0.878			
	PO_4	0.872			
	PO_5	0.833			

We employed two established techniques to assess the discriminant validity of the reflective measures: the Fornell-Larcker criterion and the heterotrait–monotrait (HTMT) ratio. The Fornell-Larcker criterion, widely used in the literature, is based on the square root of the average correlations' variance extracted (AVE) as the diagonal element, with non-diagonal elements representing the correlations between the latent variables (Hair Jr et al., 2016; Henseler et al., 2014; Lowry & Gaskin, 2014). If the diagonal values exceed any other correlation, adequate discriminant validity is established (Hair Jr

et al., 2016). As shown in Table 2, our assessment results suggest that the three reflective constructs met the discriminant validity criterion.

Table 2. Discriminant validity: Fornell-Larcker Criterion

Variables	(1)	(2)	(3)
Collaborative Culture (1)	0.857		
Coordination Technology (2)	0.465	0.850	
Project Outcomes (3)	0.576	0.498	0.853

Square root of AVE in the diagonal for reflective constructs

While the Fornell-Larcker criterion is a common approach, some scholars have argued that it is not a robust metric of discriminant validity. We used the HTMT ratio to ensure a more rigorous assessment. As shown in Table 3, the HTMT ratio values were all below the recommended threshold of 0.85, indicating acceptable discriminant validity (Asamoah et al., 2021; Hair Jr et al., 2016).

Table 3. Discriminant validity: Heterotrait-Monotrait Ratio (HTMT)

Variables	(1)	(2)	(3)
Collaborative Culture (1)			
Coordination Technology (2)	0.520		
Project Outcomes (3)	0.643	0.552	

HTMT < 0.90-Discriminant validity has been established between two reflective constructs

5.2. Measurement model assessment (formative constructs)

To validate the two formative constructs' measures, client's outcome control and client's behavior control, we assessed the collinearity between indicators using the variance inflation factor (VIF) and examined the significance of the indicators' outer loadings and weights (Cenfetelli & Bassellier, 2009; Petter et al., 2007). As shown in Table 4, all VIF values were below the recommended conservative threshold of five (Hair Jr et al., 2016). Outer loadings represent an indicator's absolute importance, whereas outer weights denote their relative importance in defining a formative construct. We tested the weights' significance through a bootstrap procedure with 5,000 samples and found that all indicator weights were significant. The collinearity test results, along with the outer loading and weight tests, suggest that the formative construct measures meet the construct validity requirements.

Table 4. Construct validity measures (formative constructs)

Formative Constructs	Formative Indicators	VIF	Outer Loadings	Outer Weight	Sample Mean	Standard Deviation	T-Statistics	P Values
Client's Behavior Control (CBC)	CBC_1	1.945	0.856	0.478	0.845	0.055	15.451	p < 0.001
	CBC_2	2.148	0.893	0.435	0.883	0.041	21.849	p < 0.001
	CBC_3	1.373	0.589	0.305	0.581	0.099	5.925	p < 0.001
	CBC_4	1.296	0.417	0.054	0.415	0.087	4.774	p < 0.001
Client's Outcome Control (COC)	COC_1	2.673	0.842	0.145	0.828	0.051	16.612	p < 0.001
	COC_2	2.482	0.892	0.398	0.88	0.047	19.105	p < 0.001
	COC_3	2.960	0.919	0.380	0.905	0.04	23.071	p < 0.001
	COC_4	1.672	0.739	0.235	0.73	0.077	9.622	p < 0.001

5.3. Structural model assessment

Our analysis of the structural model, as illustrated in Figure 2 and detailed in Table 5, shows that a collaborative culture has a significant positive impact on both client's outcome control (β = 0.449, p < 0.001) and client's behavior control (β = 0.343, p < 0.001). Additionally, coordination technology significantly influences client's outcome control (β = 0.221, p = 0.020) and client's behavior control (β = 0.393, p < 0.001). Further, client's outcome control had a significant positive effect on project outcomes (β = 0.310, p < 0.001), as did client's behavior control (β = 0.420, p < 0.001).
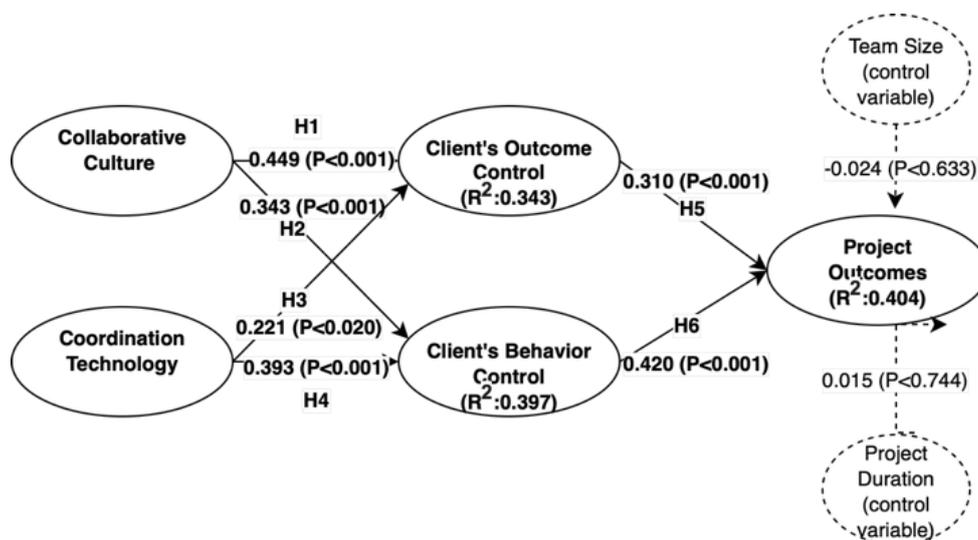

Fig. 2. Model Results

Notably, the control variables did not significantly influence the project outcomes. As shown in Table 5, all six paths without the control variables remained significant, even after including the two control variables, which provides strong evidence supporting our proposed hypotheses.

Table 5. Path coefficents and their significance

Paths	Hypotheses	Coefficients	Sample mean	Standard deviation	T statistics	P values
CC → COC	H1	0.449	0.450	0.085	5.299	p < 0.001
CC → CBC	H2	0.343	0.347	0.085	4.016	p < 0.001
CT → COC	H3	0.221	0.227	0.094	2.351	p = 0.020
CT → CBC	H4	0.393	0.400	0.073	5.395	p < 0.001
COC → PO	H5	0.310	0.324	0.074	4.204	p < 0.001
CBC → PO	H6	0.420	0.418	0.077	5.427	p < 0.001

To assess the predictive power of our model, we used the coefficient of determination (R^2 value). We found that the project outcomes had the highest coefficient of determination (R^2=0.404) in our model, followed by Client's Behavior Controls (R^2=0.397) and Client's Outcome Controls (R^2=0.343). The high R^2 values, combined with substantial and significant structural paths (coefficients close to 0.20), meet the criteria for a robust predictive model according to the rules of thumb suggested by Lowry and Gaskin (2014) and Chin (1998) (Chin, 1998; Lowry & Gaskin, 2014).

5.4. Indirect effects

Table 6 shows the Total Indirect Effects for all the paths. Collaborative culture (β =0.166, p<0.001) and coordination technology (β =0.141, p=0.002) both had significant total indirect effects on project outcomes.

Table 6. Total Indirect Effects

Indirect Effect Path	Indirect Effects	Sample Mean	Standard Deviation	T Statistics	P Values
CC → PO	0.166	0.167	0.043	3.847	P < 0.001
CT → PO	0.141	0.149	0.043	3.288	P = 0.002

We further used mediation analysis techniques to assess mediation effects and the significance of the indirect path effects. As shown in Table 7, four out of five specific indirect effects were significant at the 5% significance level (Hair Jr et al., 2016), except for the indirect effects of coordination technology on clients' outcome control (β = 0.039, p = 0.188).

Table 7. The Significance of The Mediation Path

Indirect Paths	Indirect Effect	T Statistics	P Values
CT → COC → PO	0.039	1.320	P = 0.188
CC → CBC → PO	0.089	2.684	P = 0.008
CT → CBC → PO	0.102	3.323	P = 0.002
CC → COC → PO	0.078	2.268	P = 0.024

5.5. Additional test of common method bias using a marker variable.

A marker variable test was conducted to further evaluate the potential issue of common method bias (Lindell & Whitney, 2001; Rathor et al., 2023; Xia et al., 2024). Appendix C presents the results of this test. Employing a construct-level correction approach, we incorporated a theoretically unrelated marker variable into the PLS-SEM model (Chin et al., 2012; Tehseen et al., 2017). The comparison of path coefficients and R^2 values with and without the marker variable revealed minimal differences, with path coefficient variations ranging from 0.002 to 0.032 and R^2 differences from 0.013 to 0.033. These negligible changes indicate that the exclusion of the marker variable did not substantially influence the model outcomes (Chin et al., 2012; Lindell & Whitney, 2001; Podsakoff & Organ, 1986). As such, the test further confirmed that common method bias was not an issue for our study.

6. Discussion

This study investigates how collaborative culture and coordination technology influence client's behavior and outcome controls, and how these controls affect ISD project outcomes. Our results confirm that collaborative culture at the project level is positively associated with client's behavior and outcome controls. This suggests that when project teams operate with shared norms, open communication, and mutual trust, clients are better positioned to guide procedural adherence and achieve expected project outcomes. Additionally, coordination technology use significantly enhances both types of client's controls by improving real-time visibility, enabling structured monitoring, and supporting timely communication across stakeholders (Bala et al., 2017; Ko et al., 2019).

A collaborative culture positively impacts behavior control by promoting mutual respect and high-level joint effort, leading to greater trust and commitment between client and vendor. Additionally, a shared set of norms and values can help develop a trusting relationship between the client and the vendor (Mao et al., 2008). As a result, a collaborative culture can help organizations achieve better client outcome control, which reflects the client's ability to ensure that project deliverables meet expectations. Collaborative culture can also enhance behavior control by supporting the client in assessing vendor credibility and procedural reliability (Kirsch et al., 2002; Lee & Xia, 2010).

As hypothesized, coordination technology enhances client's controls by improving real-time visibility into project activities and enabling more effective monitoring of vendor performance (Bala et al., 2017; Guinan et al., 1998). Reducing information asymmetry facilitates behavior control by allowing clients to verify adherence to agreed-upon procedures. At the same time, it reinforces outcome control by providing timely access to performance data, enabling clients to evaluate whether deliverables align with predefined expectations. Together, these capabilities enhance clients' oversight of project execution and promote more substantial alignment with intended outcomes.

Our findings further indicate that both client's behavior control and outcome control have significant positive effects on ISD project outcomes. This highlights the critical role that client's controls play in driving successful project delivery. Notably, these results diverge from those of Lakhani et al. (2013), who argued that traditional management practices such

as formal control structures, role-based teams, and performance-based incentives are less effective than collaboration-focused approaches in dynamic environments (Lakhani et al., 2013). In contrast, our analysis suggests that client's controls remain effective even in highly collaborative project contexts when embedded within a collaborative culture and supported by coordination technology. Our research model explained 34.4% of the variance in client outcome control, 39.7% in client behavior control, and 40.4% in project outcomes. These values indicate a moderate-to-strong explanatory power for the integrated model that positions coordination technology and collaborative culture as key contextual enablers in ISD projects.

7. Contributions, limitations, and future research

7.1. Theoretical contributions

This study makes three contributions to the literature on ISD project management and the broader context of outsourced software development. First, it extends prior research on client controls in ISD projects (Kirsch et al., 2002; Ko et al., 2019; Liu & Chua, 2020; Rustagi et al., 2008; Stump & Heide, 1996) by examining how client behavior and outcome controls operate within varying project contexts, particularly under the influence of collaborative culture and coordination technology. The study offers insights into how contextual conditions, collaborative culture, and coordination technology influence how clients manage ISD projects involving external vendors (Batra et al., 2017; Hoegl & Wagner, 2005; Lemmergaard, 2008; Sundaramurthy & Lewis, 2003). Moreover, our study provides a theoretical contribution by constructing and analyzing an empirical research model that highlights the relationships between project context, technology factors, the client's controls, and project outcomes.

Second, while prior research has emphasized the role of communication technologies in facilitating project coordination (Maruping et al., 2009; Persson et al., 2012), this study extends that view by focusing on the broader category of coordination technology. This encompasses a wider range of technologies, including communication technology, project management software, and collaboration platforms to facilitate collaborative work. We identified various technologies that ISD vendors use to coordinate collaborative activities and promote clients' controls. We also identified the critical coordination technology practices that enhance project outcomes. Our findings enrich the literature by showing that coordination technology supports the implementation of controls in complex ISD environments. Coordination technology supports client's behavior and outcome control by improving project visibility and communication flow, which enables clients to manage procedural adherence better and evaluate progress.

Last, our study makes a valuable contribution to the existing literature by demonstrating the impact of the project contextual variable, specifically collaborative culture, on the client's controls and project outcomes. We examined the effect of collaborative culture and coordination technology on strengthening client's control over vendors. Based on our findings, it is evident that project teams in a collaborative environment demonstrate more cohesive actions, and the client's controls may have less impact in a collaborative setting but play a significant role in determining project outcomes. Per previous research, ISD vendors must establish a harmonious relationship between cultural considerations and the client's controls to manage ISD projects effectively (Narayanaswamy & Henry, 2005). This approach aligns with our findings and can help ensure the effectiveness of controls. Our research indicates that implementing a client's controls should be accompanied by a collaborative culture environment that balances control and collaboration.

7.2. Practical implications

This study offers four practical implications that could benefit ISD practitioners. First, practitioners should balance relationship-oriented practices with structured control approaches to ensure both flexibility and accountability. Our analysis of collaborative culture provides IS practitioners with a deeper understanding of the values and facts of the collaborative

environment. Such an in-depth analysis is necessary for even experienced project managers or team leaders to realize the total potential value of collaboration.

Second, our analysis of coordination technology helps IS practitioners leverage information technology to develop products collaboratively and effectively. Information technology has transformed how organizations facilitate interaction, collaboration, and knowledge sharing among group members and stakeholders (Bala et al., 2017). In particular, coordination technology has been implemented to address the high coordination costs associated with IT project collaboration. Understanding the enabling role of coordination technology can help ISD teams manage task dependencies more effectively.

Third, this study's results illuminate the role of collaborative culture in supporting client's behavior and outcome controls, offering valuable insights to practitioners. The findings suggest that a collaborative team culture can enhance client's control over ISD projects. However, it should be integrated into a broader project management strategy emphasizing building solid relationships and promoting effective communication and collaboration between clients and vendors.

Last, our research model can bridge the gap between IS theories and practice. The validated research model can serve as a practical tool for organizations seeking to assess their control environment. By evaluating how collaborative culture and coordination technology shape control effectiveness and project outcomes, teams can identify areas for improvement. The survey instrument developed for this study may also support professional development, team assessment, and adaptive project management interventions.

7.3. Limitations and future research

This study had several limitations that should be considered when interpreting the findings. First, we did not explicitly consider the effect of contract characteristics on our core variables, which may significantly impact the results. Future studies should explicitly consider the impact of contract terms on client-vendor collaboration. Second, the measurement perspective was mainly from the standpoint of ISD vendors, which may limit the generalizability of the findings. We recommend that future research include measures from both vendor and client perspectives and explore other project outcomes, such as team performance outcomes. Last, our findings may be limited in general to the context we studied (ISD projects involving client-vendor collaboration). Future research could expand the study to include other industries and countries.

8. Conclusion

This study investigated how collaborative culture and coordination technology influence client's behavior and outcome control, and how these controls affect project outcomes in the context of ISD projects. Building on prior research in ISD project management and project context, we developed and tested an empirical model that integrates environmental and technological enablers with client control practices. We emphasize the importance of creating a collaborative working environment and leveraging coordination technology to support client's controls. The findings confirm that both collaborative culture and coordination technology are critical contextual factors that shape the effectiveness of client control.

Collaborative culture strengthens clients' ability to apply behavior and outcome control by fostering trust, communication, and shared understanding within project teams. Coordination technology, in turn, enhances project visibility and reduces information asymmetry, enabling clients to monitor procedural adherence and assess progress toward project goals. Rather than treating control and collaboration as opposing forces, the study demonstrates that they can be complementary. Collaborative culture provides the social foundation for effective control, while coordination technology offers the structural

tools necessary to execute control in distributed ISD environments. Together, these enablers contribute to improved project performance.

This research contributes to the literature on ISD project management by empirically validating a model that connects contextual factors to client's controls and project outcomes. The results suggest that organizations seeking to improve ISD performance should invest in cultivating collaborative team environments and adopting coordination technologies that support structured yet adaptive project management practices.

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Appendix A: Sample Characteristics

Project Background

Customer Country

Country	Frequency	Percent
China	164	74.50%
Japan	23	10.50%
US, Canada	12	5.50%
Europe	9	4.30%
Australia	2	1.00%
Hong Kong	2	0.90%
South America	1	0.50%
Others	5	2.80%
Total	218	100.00%

Respondent Position

Job Position	Frequency	Percent
IT Development Engineer	55	25.23%
Data Development Engineer	11	5.05%
Test Engineer	9	4.13%
Sales and Marketing	12	5.50%
Project Manager	42	19.27%
Senior IT Development Engineer	6	2.75%
Department Manager	32	14.68%
Senior Management	15	6.88%
Others	36	16.51%
Total	218	100.00%

Project Team Size

Members	Frequency	Percent
1-6	26	11.93%
7-15	67	30.73%
16-30	49	22.48%
31-50	34	15.60%
51-80	4	1.83%
81-100	5	2.29%
100+	23	10.55%
Missing	10	4.59%
Total	218	100%

Project Domain

Domain	Frequency	Percent
Education	30	13.76%
Transportation	5	2.29%
Finance	22	10.09%
Insurance	8	3.67%
E-Commerce	21	9.63%
Telecomm	8	3.67%
Manufacturing	15	6.88%
IT and Software Application Development	54	24.77%
Life Sciences	2	0.92%
Healthcare	4	1.83%
Construction	4	1.83%
Entertainment	2	0.92%
Other	40	18.35%
Missing	3	1.38%
Total	218	100.00%

Appendix B: Variables and Measures

Variables	Measures	Key References
Collaborative Culture	1. Our team is a very personal place. It is like an extended family. People seem to share a lot of themselves. 2. The management style of our team is characterized by teamwork, consensus, and participation. 3. The glue that holds our team together is loyalty, organizational commitment, mutual trust, and teamwork. 4. Our team emphasizes human development. High trust, openness, and participation persist.	(Cameron & Quinn, 2005)
Coordination Technology	1. The coordination tools we use enable us to resolve task dependencies in the project. 2. We use software tools to coordinate with our client on project changes in a timely manner. 3. Our client can use project coordination tools to evaluate our work-in-progress software product. 4. Our client can use project coordination tools to regularly monitor our work progress.	(Guinan et al., 1998)
Client's Outcome Controls	1. Our client emphasized timely project completion. 2. Our client emphasized completing the project to their satisfaction. 3. Our client emphasized predefined quality indicators for the project. 4. Our client emphasized completing the project within budget.	(Henderson & Lee, 1992; Kirsch et al., 2002; Lee & Xia, 2010)
Client's Behavior Controls	1. Our client expected us to follow an agreed upon written sequence of steps in doing the project. 2. Our client assessed the extent to which we followed existing written procedures and practices during the project. 3. Our client explained to us how the project jobs should be done. 4. Our client actively controlled how our team human resources were planned and managed.	(Henderson & Lee, 1992; Kirsch et al., 2002; Lee & Xia, 2010)
Project outcomes	1. Our project was completed on time according to the original schedule. 2. Our project was completed within budget according to the original budget. 3. Our client was satisfied with the project quality. 4. The completed system met its scope of requirements. 5. The completed system delivered practical value and benefits to the client.	(Kirsch et al., 2002; Lee & Xia, 2010)

Appendix C: Marker Variable Test

Paths	Without Marker Variable		With Marker Variable	
	Path Coefficients	P Value	Path Coefficients	P Value
CBC -> PO	0.420	P < 0.001	0.394	P < 0.001
COC -> PO	0.310	P < 0.001	0.278	P < 0.001
CC-> CBC	0.342	P < 0.001	0.340	P < 0.001
CC -> COC	0.449	P < 0.001	0.424	P < 0.001
CT -> CBC	0.393	P < 0.001	0.368	P < 0.001
CT-> COC	0.221	P = 0.020	0.209	P = 0.028

Biographical notes

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