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Client-Vendor Collaboration in Information Technology Development Projects And Its Emerging Outcomes

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CLIENT-VENDOR COLLABORATION IN INFORMATION TECHNOLOGY DEVELOPMENT PROJECTS AND ITS EMERGING OUTCOMES

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To: Acting Dean Jose M. Aldrich
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This dissertation, written by Mingyu Zhang, and entitled Client-Vendor Collaboration in Information Technology Development Projects and its Emerging Outcomes, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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DEDICATION

This dissertation is dedicated to my mother and father; thank you for always supporting me and believing in me. I also dedicate this dissertation to my friends who have supported me throughout the process. I would not be where I am today without your help and support.

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ABSTRACT OF THE DISSERTATION

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This study investigates the key dimensions of IT project collaboration and its outcomes. We conceptualized key dimensions of client-vendor collaboration, and its emerging outcomes based on literature reviews. Then, we proposed a new research framework that links IT development processes to IT project client-vendor collaboration which in turn affects the outcomes of IT project. We examined the key dimensions of IT project collaboration and their impacts on project outcomes. We identified four critical IT development processes and technologies that contribute to the development of project collaboration.

Our results include: (1) Coordination practices and technologies (such as communication quality and coordination technology) significantly influence the effectiveness of IT development.; (2) IT project collaboration can be conceptualized as consisting of two related but distinct constructs: cooperation

structure and joint development; (3) IT development processes jointly influence the formation and the development of IT project collaboration. We also found that knowledge-sharing activities significantly improve the usage level of the iterative requirement generation process. (4) Different collaboration behaviors as indicated by IT project collaboration constructs affect two types of outcomes: project performance outcomes and emerging outcomes. IT project collaboration significantly improve both the emerging outcomes (such as team cultivation and relational outcomes) and performance outcomes (time, schedule and functionality). (5) Trust fully mediates the effect of cooperation structure on performance outcomes; suggesting that common rules and structures cannot directly benefit project performance without members' believing in those rules and agreements.

Through IT project collaboration, IT vendors can achieve not only traditional project outcomes but also emerging outcomes such as team cultivation and client-vendor relationship building. The relationships among IT development processes and technologies, project collaboration, and the outcomes of project collaboration are much more complex and dynamic than what the extant literature has portrayed. Multiple factors jointly influence the processes of IT development. Different patterns of client-vendor collaboration also affect the outcomes of the project, in addition, the trust level between the vendor and the client plays a major role in mediating the relationship between client-vendor collaboration and project performance.

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CHAPTER 1

1. INTRODUCTION

Chapter 1 is divided into a few parts: background review of IT outsourcing, identification of research gaps, presentation of the current research opportunities, and the development of research questions and objectives.

1.1 Background

IT outsourcing is among the most discussed topics in both the academic and practitioner media (Rustagi, King, & Kirsch, 2008). It has created a number of research streams on a broad range of topics such as its impact on GDP, inflation, trade, consumers, productivity, wages, gaining prominence in IT industry (Bednarzik 2005). McKinsey (2003) concluded that the United States' economy has been benefited greatly and significantly from subcontracting; outsourcing activities help reduce costs for IT and other services by 60%, empowering the U.S. firms in the international marketplaces to become stronger and more competitive from this advantage (Agrawal and Farrell 2003). According to Blinder's research, 42 million to 56 million U.S. jobs are potentially outsourceable (Blinder 2009). Forrester Research projected that about 3.3 million U.S. services jobs could be moved abroad by 2015 (McCarthy 2004, September 2010 #99658).

Chinese IT vendors are at a relatively early but rapidly growing stage compared to more established multinational IT development outsourcing locations, India IT development outsourcing vendors in particular (Ning 2013; Palvia et al. 2010). While India has been the leading destination, China represents a large potential service provider that has been largely ignored (Mao, Lee, & Deng, 2008).

China is managing to transform its position from an export structure concentrated in labor-intensive and low-tech products towards a structure concentrated in capital-intensive and high-tech products (Naudé et al. 2016). Following the national economic trend, Chinese companies are shifting their positions from a labor-intensive business to an innovation-driven business (Griffith and Miller 2016). To catch the new trend and to seize the new market opportunity, Chinese IT industries are moving from production to more innovative value-added activities (Li et al. 2015) and incrementally transforming their positions from the traditional owner vs. contractor based outsourcing practices to a more mutually dependent and shared-value based joint effort (Vlaar et al. 2008).

Today's IT industries have evolved from implementing well-defined business functions to discovering and redefining business functions; innovation has become a part of IT companies' core value (Du and Pan 2016). IT project clients frequently change their requirements after a product design has begun, but they expect the product to be delivered without delay (Harter et al. 2000). Requirement changes have become a constant in IT development process, as it is in every design based process. Even with well-defined scope and requirements, IT projects still experience significant business and technology changes during the implementation process. The embeddedness of the constant business and technical changes result in a significant development complexity and make effective configuring and planning software development become a challenging task for IT outsourcing vendors.

The previous section has introduced the history of IT outsourcing and how it has evolved in China. China and India have been stated as background information. The section focuses on the background introduction of IT outsourcing to provide a brief introduction to our project setting and the data source (China). While the historical review of IT outsourcing is critical for the understanding of the overall research context, the context was mentioned as background information. In the next section of this chapter, the research problem statement and research questions will be presented.

1.2 Problem Statement and Research Questions

Nowadays, IT outsourcing results have been improving as the practice of outsourcing becomes more matured (Willcocks and Kern 1998). However, there are still continued problematic outsourcing outcomes that have been repeatedly demonstrated in IT and Business studies. Research has demonstrated that the intended outsourcing benefits are not realized as planned and risks associated with the outsourcing are often poorly managed (Bahli and Rivard 2003; Gonzalez et al. 2010; Lacity et al. 2009; Liang et al. 2016; Willcocks et al. 1999). Studies have revealed that many IT outsourcing clients are willing to grant the expense of canceling their contracts with the outsourcing service providers and rebuilding their in-house IT capabilities (Levina and Ross 2003).

Under today's consistent changing business environment, IT projects frequently fail as a result of the lack of consideration of the IT development practices, project collaboration practices, and project contexts (Banker et al. 1998; Hoegl and Wagner 2005; Sabherwal 2003).

In addition, previous studies on relationship management have pointed out that the single directional focus of knowledge-sharing and IT design practices is one of the leading causes of the problematic outsourcing outcomes (Du and Pan 2016; Hoegl and Wagner 2005). Two case scenarios can be used to illustrate the single directional focus circumstances. For example, (1) in case one, an IT development project can be driven by the client's desire, the client has the in-house IT development capability and IT knowledge. They have documented the software requirements and created their project plan, outsourced the coding tasks to IT development vendor and expected the vendor to follow their project plan. Thus, the vendor team has to follow the client's project plan and the response to client's project control desire. (2) In case two, an IT development project can be driven by vendor's desire; the client may not have the in-house IT development capability and knowledge. They are looking for an IT development vendor to transfer their business requirements to a concrete IT project. In that case, the vendor team has the decision power of this IT project; they can develop the software based on their objectives (such as time saving, or resource saving). Thus, the client loses its controlling power and the opportunity to be involved in the design process of their IT product. However, both cases are confrontational and are based on the fact that one party must dominate and the other must follow (Barnes et al. 2009). These are not effective cases for IT development projects. Under the confrontational IT development model, client and vendor do not have sufficient knowledge-sharing activities. The IT development process is driven by role based management. Thus, the demanding controls of the client are restricting the vendor from offering customizable, innovative solutions or functionality improvements through collaboration, which in turn further discourages the vendor's motivation to develop any strategic relationship with the client (Kedia and Lahiri 2007).

The dynamics of current business environment require the constant evolution of software design. New development ideas should be incrementally adopted during the whole software development cycle. In todays' new business environment, traditional IT development models (such as that illustrated in the confrontational model) have demonstrated their limitations. Thus, it is necessary for us to re-evaluate and re-design the IT project development structure and to recognize client-vendor relationship in a new and productive way. Closer client-vendor relationships, frequent knowledge-sharing, and joint development may significantly improve the quality of the IT projects, reduce project uncertainty, and, eventually, improve the quality of the final product. In particular, researchers should pay more attentions to the critical role of coordination — the effective alignment and adjustment of the partners' actions (Gulati et al. 2012). IT vendors must acknowledge the fact that there could be no business and no profits unless the client is recognized as a leading stakeholder (Barnes et al. 2009).

1.3 The Notion of IT Project Collaboration

In the IT development outsourcing environment, collaborative behaviors are enabled by the IT development processes. How to select, adopt, and tailor these processes has always been at the core of the IT field (Agerfalk et al. 2009). To serve the purpose of maintaining or forming a collaborative relationship with clients, various interactive IT development processes (such as knowledge-sharing and incremental requirement generation cycle) have been adopted by IT outsourcing vendors as the mediums to enable collaboration (Hoda et al. 2011). Thus, the emphases of the project collaboration are on the creation of joint actions and the formation the cooperation structures. These two concepts co-exist in any IT collaboration behaviors. The joint actions focus on the interpersonal problems solving, shared visions and joint pursuit of project objective. The cooperation structure provides the initial and continuous clarity and protection on each party's commitments, roles, responsibilities, expectations, and resource needs.

1.4 The Interactive Role of the IT Development Process and Technology

While relational factors, such as trust, and prior relationship are fundamental in collaborative behaviors (Smith et al. 1995). These factors failed to capture the unique characteristics of IT project collaboration, the objectives of IT project collaboration are to form or reshape their positions with their clients. New studies should focus on the formation of a collaborative relationship, the continuity of collaborative relationships, and the feedback mechanisms in collaboration (Smith et al. 1995).

IT development collaborations between client and vendor have a significant influence on the dynamics and practices of the development, including project management practices, communication patterns, contracts, and interpersonal relationships (Smolander et al. 2016). In the past few years, advanced IT coordination, development processes and technologies have not only gained increasing adoption in practice, but have also rapidly become mainstream of IT development approaches (Liang et al. 2016; Smolander et al. 2016). These processes have been adopted by IT vendors as solutions to improve a vendor team's ability to embrace and respond to the client's changing requirements, thus enabling vendor teams to cope with client's unpredictable and evolving needs (Lee and Xia 2010; Maruping et al. 2009). However, although IT project collaboration can significantly enhance the quality and outcomes of an IT project, little reported research has examined the roles that IT coordination and development processes and technologies play in achieving IT project collaboration. Thus, there is a critical need for investigating IT development processes' roles in enabling IT collaboration.

1.5 Emerging Outcomes

Collaboration has been suggested as a way to develop new solutions to complex problems (Lawrence et al. 2002). Therefore, it has the potential to transform institutional outcomes by acting as an important source of innovation (Phillips et al. 2000). While collaboration can play a role in the establishment of new institutions and diffuse them inter-organizationally, these new institutional effects, such as improved practices, new technologies, and enhanced rules cannot be easily determined in a short period of time. These new institutions, which are established through the activities of a single collaboration, may not be observable organizationally. However, such new institutions can be observed by using a lower level of analysis, such as project level analysis that we have performed in this research. These institutions are narrowly diffused and only weakly entrenched, but have the potential to become widely institutionalized organizationally (Lawrence et al. 2002). For example, a vendor team may improve its IT development process through the activities of a single project collaboration by learning how to collaborate with its client more effectively, and may implement their improved processes in future projects. However, these new processes or practices may be not significant enough to be directly observable at the organizational level or may not produce positive outcomes in every situation that maybe be observable in a short period of time. However, if they keep accumulating experience and knowledge, in the future, the team's internal processes may have the potential to become common development processes and may be shared with the entire organization. The phenomenon has been referred to as proto-institutions. While these new practices, technologies, and rules are not diffused in a large scale, they have the potential to be fully institutionalized in the further if the organization is given enough time and support.

Many previous studies have failed to capture these more diffused outsourcing outcomes but have mostly focused on the operational and economic benefits of collaboration (Smith et al. 1995). The long-term strategic value of IT project collaboration may be in the learning and the growth of the development team and the relationship building between the client and the vendor. The learning and growth of the development team would help them effectively respond to the client's requirement changes that might occur during a project (Maruping et al. 2009). However, depending on the focus of a project, project collaboration may not offer direct economic but other forms of benefits to the software development vendors.

1.6 Research Questions

Our review of the existing literature on IT outsourcing and our field study gave rise to the following three research questions:

Question 1: What are the key dimensions of IT project collaboration?

Our research focuses on the creation of project collaboration through the use of interactive IT development processes, which represent an opportunity for IT professionals and scholars to bridge a critical gap that exists in the literature. By taking a micro view to examine the client-vendor relationship at the project team rather than the organizational level, we will investigate the key dimensions of IT project collaboration, the relationship among them, and describe the functions of these key constructs on the creation project collaborations.

Question 2: To what extent an IT project collaboration is influenced by coordination and development processes and technologies.

The question is designed to answer the question of what roles of coordination and development processes and technologies play in the creation of IT collaboration.

By answering this question, this study is expected to provide empirical evidence for the interactive role of IT development processes plays in the creation of IT project collaboration.

Question 3: How could IT project collaboration benefits IT vendors?

Previous studies have pointed out the root outcomes of the collaboration in other research settings (Hardy et al. 2003). However, little is known about to what extent such findings apply to IT development context. Are there other essential measures that are more prominent in an IT development environment than those that have been used in the existing measures (in terms of project performance, team cultivation, and improvement of relationships)? Are there factors that mediated the impacts of project collaboration on project outcomes? These questions form the foundation of our research.

Question 4: To what extent is the IT project collaboration influenced by project context (such as team culture and client's controls)?

It seems reasonable to expect that IT project collaboration is affected by the IT project context (such as team culture and client's controls), but it is less obvious what are the roles that contextual factors (such as team culture and client's controls) play in influencing IT project collaboration and its outcomes.

CHAPTER 2

2. LITERATURE REVIEW

Chapter 2 begins with a definition of client-vendor collaboration, followed by a review of literatures on IT project outcome assessment, IT project collaboration relationship, IT coordination and development practices, and emerging outcomes of collaboration. Comprehensive construct development discussion will be presented in Chapter 3.

2.1 Concepts of Client-Vendor Collaboration

Collaboration is a dynamic process which focuses on the feedback mechanisms and shared decision practices of a collaborative relationship (Smith et al. 1995). Most of the prior studies on client-vendor collaboration have focused mostly on cost minimization using a single-party analysis (Zajac and Olsen 1993) and on perceived collaboration as prior relational factors, capability and hierarchical governed static social phenomenon (Krause et al. 2007). Even though static social relational factors, such as trust, are fundamental in developing cooperative relationships (Smith et al. 1995), these static assumptions fail to capture the unique characteristics of IT project collaboration which is often bonded with their clients and with cultivating their teamwork capability. Research is needed to focus on the creation of collaboration, the continuity of collaborative relationships, and the feedback mechanisms in collaboration (Smith et al. 1995).

To seize the emerging market opportunity and keep competitiveness in the today's fast changing market environment, many IT vendors have transformed their service functions from product manufacturing or execution to product co-development. Under this emerging trend, client-vendor collaboration becomes an essential strategy in today's complicated environment (Lawrence et al. 2002). Under this new trend, IT vendor and its client attempt to create a collaborative co-work relationship and start to treat each other as partners rather than being just contractors aimed at reducing operational expenses (Kedia and Lahiri 2007). Such new cooperative structure often encourages the creation of new opportunities and produces some forms of innovations (Gray 1989). Through the formation of new collaborative associations with their clients, IT project teams can seize new opportunities and can improve its service quality.

2.2 The Outcome Assessment of IT Project

Previous studies on IT project development and its results predominantly focus on the evaluation of project operational performance (such as time, schedule and functionality). However, as a type of revenue-driven organizations, IT vendors have broader and more empirical outcome evaluation standards and emphases, which are not necessary to be profits based. Non-economic (such as managerial, team cultivation, relational) outcomes are also essential focuses for the organizations. To fill the gap and to understand IT vendor's efforts to improve team capability and service quality through IT project collaboration, we develop a research model based on previous research and on our empirical field observations. Based on our assumptions, by establishing a collaborative project association with the client, IT vendors are able to empower project collaboration, which can lead to the success of projects as measured not only by project performance (effectiveness and efficiency) but also by the personal success of team members (team cultivation and learning) (Hoegl and Gemuenden 2001).

2.3 IT Project Collaboration

Collaboration can be defined from the perspective of psychological motivation (Deutsch 1949; Mead 2002) or from the perspective of behavioral patterns (Argyle 2013; Barnard 1968; Chen et al. 1998; Hoegl and Wagner 2005; Tjosvold 1988). The psychological motivation perspective focuses on the psychological drives of collaboration such as social situations, shared goals or participant's intentions of cooperation (Chen et al. 1998; Deutsch 1949). The behavioral perspective emphasizes on the patterns and behaviors of cooperative activities, such as cooperative actions, interpersonal interactions, and inter-organizational knowledge-sharing (Argyle 2013; Dahl 2014; Hoegl and Wagner 2005).

The notion of collaboration has been clearly distinguished by the previous studies. The perception of collaboration remains contextually grounded. Different studies usually focus on different angles that have been used to study collaborative behaviors. Thus, the measurement of collaboration is always context based. Barnard (1968) conceptualizes collaboration as a functional system of activities of two or more persons., His research on collaboration clarified how individual actions and efforts are joined and synthesized into cooperative actions (Barnard 1968).

Tjosvold (1988a) identifies four dimensions associated with a collaborative relationship: (1) exchanging and combining information, ideas, and other resources; (2) giving assistance; (3) discussing problems and conflicts constructively, and (4) supporting and encouraging each other (Tjosvold 1988). Chen's research on collaboration has identified a few collaboration mechanisms, such as superordinate goals, group identity, trust, accountability or perceived criticality, and reward structure and incentives (Chen et al. 1998). Argyle summarizes the pattern of successful collaborative workgroup behaviors such as coordination, interpersonal help, and division of labor (Argyle 2013). Hoegl's research on buyer-supplier collaboration advanced the concept of collaboration by developing a project level measurement. They defined the four domains of project level cooperation as flexibility, information exchange, shared problem-solving, and restraint in the use of power (Hoegl and Wagner 2005).

Zajac and Olsen (1993) proposed a stage model of collaborative relationships composed of an initializing stage, a processing stage, and a reconfiguration stage with feedback loops to the earlier stages. Their discovery of the feedback loops of the cooperation is one of the initial concepts that treat collaboration as a dynamic process where participants constantly evaluate their decisions for continued cooperation (Zajac and Olsen 1993).

Based on our research context, we examined the IT project collaboration from the setting of collaborative activities and focused on both behavioral and contractual activities of IT projects. We define these generalizable collaboration activities as collaboration patterns. These patterns co-exist in IT collaboration activities. Offered with sufficient time and effort, these collaboration patterns will also enable opportunities for future collaboration. In the next chapter, these constructs will be presented in details.

2.4 IT Coordination and Development Practices

2.4.1 Coordination Practices and Technology

IT project coordination is one of the major efforts an IT vendor can make to assist client's information sharing requirements and deal with developmental uncertainties. To better cooperate with the client, the project team needs to constantly communicate with the client to confirm project design and coordinate project related problems. A project that requires a significant level of teamwork with the client is more likely to adopt and use coordination practices and tools, such as communication and coordination technologies.

Communication

To deal with project development uncertainties, the project team needs to frequently communicate with the client to verify and confirm project design and coordinate project related problems. Frequent communication as the most fundamental coordination mechanism is also one of the most fundamental criteria for project success (Jain and Suman 2015). Clients' involvement and collaboration opportunity always begin with in-depth and on-time communication. Through frequent communication, the client will have a much clearer understanding of the project outcomes and product quality.

Coordination Technology

As a result of the high coordination cost associated with IT project collaboration, some project teams prefer to structure their project coordination procedures over coordination tools for the purpose of development support. There are two types of understanding regarding the importance of coordination. Some researchers argue that tools and techniques make critical differences (Guinan et al. 1998; Williams et al. 2011), whereas the behavioral researchers suggest that interpersonal relationship, interpersonal interactions are most important factors in determining success (Ancona and Caldwell 1992; Jassawalla 2003; Smolander et al. 2016). However, no one would argue that either perspective is complete by itself (Guinan et al. 1998). To achieve a more compressive understanding of the IT project coordination, we measured coordination usages from both the technological perspectives (coordination technology) and the behavioral perspectives (communication).

In IT project collaboration context, because of the remote collaboration prerequisite, the client is only able to evaluate project progress at the end of each development iteration and to provide feedback and new requirements based on the demonstration of the development team. Thus, within each iteration, IT development tasks and working progress are not entirely viewable or accessible to the client. The lack of task progress information can cause performance ambiguity. When project collaboration is based on observing the other party's actions and responding to them, performance ambiguity can make collaborative tasks more difficult (Heide and Miner 1992). Thus, implementing remotely viable coordination technologies is a critical expectation for project collaboration. Table 1 shows the summary of the two different perspectives of coordination.

Dimensions	**Definition**	**Reference**
Communication	As the most basic and the most fundamental coordination practice, communication with clients is operationalized in terms of the extent to which the client and vendor (a) timely exchange of information (b) effectively exchange of information, and (c) informally exchange of information.	(Gibson and Birkinshaw 2004), (Hoegl and Wagner 2005), (Jae-Nam and Young-Gul 1999),
Coordination technology	Emphasis on the enabling and supporting role of coordination tools. A major role of coordination tools is to coordinate various activities both externally with clients and internally within the development team. Coordination tools can support the interactions of multiple stockholders and enable the connection with its client.	(Guinan et al. 1998; Williams et al. 2011)

Table 1: Two Different Perspectives of Coordination

2.4.2 The Interactive Role of IT Development Processes

IT development processes are critical for project collaboration. Project collaboration requires clients to act as bidirectional creators to help the development team in various ways, such as validating product architectural choices or evaluating product requirements (Blazevic and Lievens 2008). Thus, knowledge-sharing and exchange between two parties will help them confirm new market conditions and include new ideas and knowledge during product development, which would enhance their market knowledge and thus their innovation efforts (Blazevic and Lievens 2008). The main objective of the interactive IT development processes is to increase the interactions in the product design phase and to further increase project collaboration. Interactive IT development processes allow project teams to be immersed in interactive development processes such as (1) knowledge-sharing and (2) iterative requirement generation. In the next chapter, these constructs will be presented in details.

2.5 Trust

Trust refers to a situation in which a trustor must develop enough confidence in a target's motives and future behaviors to be willing to rely on that target in a situation that is potentially risky for the trustor (Doney et al. 1998).

Multiple pieces of research in interorganizational relationship have emphasized the vital position of trust within client-vendor relationships. Previous research suggests that occasional reliance on socially embedded relations often produces sufficient levels of trust and obligation between parties to efficiently avoid market failure and the need for full internalization of transactions within a hierarchy (Dore 1983; Gambetta 1988; Granovetter 1985; Lincoln 1990; Powell 2003; Ring and Van de Ven 1992). In inter-organizational relationships, researchers credit trust with lowering transaction costs in uncertain environments (Doney et al. 1998；Dore, 1983 #22766; Noordewier et al. 1990); while internally, trust contributes to effective implementations of strategy, greater managerial coordination, and more effective work teams (Doney et al. 1998; McAllister 1995). Doney’s research on trust suggests that when the trustors and the targets share the same norms and values, there is a greater chance that a trusting relationship will form because the direction the target takes to earn trust is the same route the trustor follows to establish whether or not the target is trustworthy (Doney et al. 1998). A survey-based study on IT project success proposed that trust has a significant effect on project success from both the business and the user perspectives (Jae-Nam and Young-Gul 1999). Chen’s study on trust-building mechanisms show that trust-building mechanisms have the strongest positive effect on information sharing, mutual trust, and reciprocal commitment (Chen et al. 2011). Mutual trust is an essential feature for ensuring quality and success of inter-organizational, collaborative ventures. If two parties need to benefit from each other, it is required that they trust each other and appear mutually trustworthy. Clients need to trust their vendors with regard to desired quality and timing of service delivery and non-display of opportunistic behavior that might lead to loss of control over the outsourced activities (Kedia and Lahiri 2007). However, the influence of trust on the client-vendor relationship has not been adequately studied (Gainey and Klaas 2003; Kedia and Lahiri 2007; Langfield-Smith and Smith 2003).

The following trust building behaviors have been identified based on our literature reviews: (1) Calculative Trust: Trustor calculates the costs and rewards of a target acting in an untrustworthy way. (2) Prediction Trust: Trustor develops confidence that a target's behavior can be predicted. (3) Intentionality Trust: Trustor evaluates a target's motivations. (4) Capability Trust: Trustor assesses a target's ability to fulfill his or her promises. (5) Transference Trust: Trustor draws on proof sources from which trust is transferred to a target (Doney et al. 1998; Poppo et al. 2015; Rustagi et al. 2008). Table 2 summarizes the characteristics of trust as considered in this study.

Characteristic of Trust	
Characteristic	Definition
Calculative	Trustor calculates the costs and rewards of a target acting in an untrustworthy way.
Prediction	Trustor develops confidence that a target's behavior can be predicted.
Intentionality	Trustor evaluates a target's motivations.
Capability	Trustor assesses a target's ability to fulfill his or her promises.
Transference	Trustor draws on proof sources from which trust is transferred to a target.

Table 2: Characteristic of Trust

2.6 Project Outcomes

There are two main emphases on IT project outcomes in the literature: (1) the project performance and (2) the emerging outcomes of the team. Project performance outcomes are mainly operational based short-term impacts such as efficiencies, cost savings, and productivity (Xia and Lee 2003). These outcomes focus on traditional outsourcing project performance assessment such as on time, on schedule, and on budget. Project performance is a representation of the basic needs of an IT project, emphazing the functionality, quality (functionality Improvement) and schedule of the project.

2.6.1 Emerging outcomes

It is crucial for researchers to investigate the emerging (institutional) outcomes of an IT project, such as team cultivation outcomes and relational outcomes. Unlike project performance outcomes' economic focus, these emerging outcomes are noneconomic and mutually beneficial. There is a general lack of research that conducts a theory-based empirical examination of project outcomes from the perspective of IT vendors (Palvia et al. 2010). We adopted Proto-Institution theory to interpret the emerging outcome. Institutions are defined as relatively widely diffused practices, technologies, or rules that have become entrenched in the sense that it is costly to choose other practices, technologies, or rules (Lawrence et al. 2002).

2.6.1.1Team Cultivation

Collaborative activities can generate new social patterns and those social patterns that, when chronically reproduced, owe their survival to relatively self-activating social processes (Jepperson 1991). Through IT project collaboration, new team structures have been created, and new job structure has been constructed. In other words, IT project collaboration can produce and advance project team's IT practices, technologies, and rules. Collaboration played a crucial role in the production of new institutions by diffusing the new institutions (practices, technologies, and rules) inter-organizationally. Such newly created practices, rules, and technologies that transcend a particular collaborative event may become new institutions if they diffuse sufficiently (Lawrence et al. 2002).

2.6.1.2 Relational Outcomes

As a result of the client-vendor collaboration, a more profound collaborative relationship, such as partnership, extended service contract, and alliance can be formed or reformed as the outcome of project collaboration. However, despite its essential position in IT collaboration, the phenomenon has not received adequate attention in the scholarly literature (Kedia and Lahiri 2007). Even fewer researchers have addressed collaboration as emerging phenomena. Client-vendor collaboration is the joint action of the two parties, which can be characterized by integrative interactions and cooperation (Grover et al. 1996). Jae-Nam's research indicates that the profound relationship could be formed through collaborative activities such as participation, cooperation, communication, and information sharing. Thus, client-vendor collaboration serves as a key indicator of IT vendor's continuous profits (Jae-Nam and Young-Gul 1999; Xia and Lee 2003). Kumar and Palvia (2002) identified several management strategies that contribute to the building of effective relationship, including control, coordination, communication, and conflict management. One of the main practices to form a more profound collaboration with the client is through constant relationship building, which is a continuous and incremental process. However, few researchers address collaboration as emerging phenomena. Through the continued project collaborations, clients and vendors constantly form and reform their collaborative structure to shape or enhance their partnership.

The Impact of Team Culture on IS Collaboration

Previous studies have suggested that project contexts play a vital role in project collaboration, quality, and performance (Cartaxo and Godinho 2012; Hempel et al. 2012; Klimkeit 2013; Newhouse et al. 2013; Park and Luo 2001; Sila 2007; Tsoukas 1994 ; Van der Smissen et al. 2014). Context has been found to influence an organization's choices and uses of its work structure, work practices, and collaboration practices (Bechky 2011; Bresman and Zellmer-Bruhn 2013; Hempel et al. 2012; Kimberly and Evanisko 1981; Oldham and Hackman 1981). An organization's internal development process is embedded and connected with other developments; it cannot be considered a completely separate process without any contextual and environmental imprints (Child 1997; March 1994; Sydow et al. 2009). In other words, contextual and environmental characteristics matter, the rules and the culture that make up organizations. An organization must find a match between the demands of its competitive environment and its management structures in order to survive and succeed (Venkatraman 1990). Thus, an environmental characteristic (such as project team's culture and client's control styles) is expected to affect all organizations within that industry. Success for any firm will depend on its adoption of appropriate response mechanisms sufficient to deal with relevant environmental factors (Simerly and Li 1999; Sydow et al. 2009).

An IT project team's culture can significantly influence IT project development (Mao et al. 2008). Sharing the same norms and values enable the two parties to develop a trusting relationship (Doney et al. 1998). The effectiveness of organizational mechanisms for forming collaborative relationships are moderated by organizational culture (Chen 1998). In this study, we focus on the influences of a project team's culture and client's control mechanism on project collaboration and their outcomes.

2.7 Client's Control Practices

IT development teams vary in their cultures, management styles, and collaboration intentions. In some cases, the development team may incorporate more to client's management styles during the development process. The process of management alignment is usually achieved through client's control mechanisms (Sarangi and Slembrouck 2014). Client's control could be viewed as the client's attempts to ensure that individuals working on organizational projects act according to an agreed-upon strategy to achieve desired objectives (Sarangi and Slembrouck 2014). Rustagi et al. (2008) defines control as attempts by individuals or organizations to influence the actions and behaviors of other individuals or organizations by using certain mechanisms to better achieve organizational objectives. Harris et al. (2009) defines control as a study of the mechanisms that can be used to achieve organizational objectives. Thus, the understanding of client's control provides a great insight to enable the two parties (client and vendor) to act according to an agreed-upon strategy to achieve desired objectives.

CHAPTER 3

3. RESEARCH MODEL AND HYPOTHESIS DEVELOPMENT

The focus of this research is on IT development projects, where we investigate how to make IT project collaboration produce the desired results, such as project success, team development, and relational bonding. Figure 1 illustrates the research model. We built our research model based on IT management, client-vendor collaboration, and team management literature and specified how different IT development processes contribute to the success of client-vendor collaboration in IT product development at the project level. As shown in Figure 1, the research model suggests that (1) IT vendors' selection and usage of IT communication technology (such as the usage of coordination technology, and the quality of communication) influence key aspects of IT development processes (knowledge-sharing and iterative requirement generation). (2) Vendors' IT development processes (such as knowledge-sharing and iterative requirement generation) could impact the creation and the effectiveness of IT project collaborations over two collaboration constructs: joint development and cooperation structure. (3) Intensive joint development behaviors and well-built cooperation structures may produce various outcomes (such as project performance outcome, team cultivation outcome, and relationship outcome). However, mutual trust between the two parties may change the expected performance outcomes[1].

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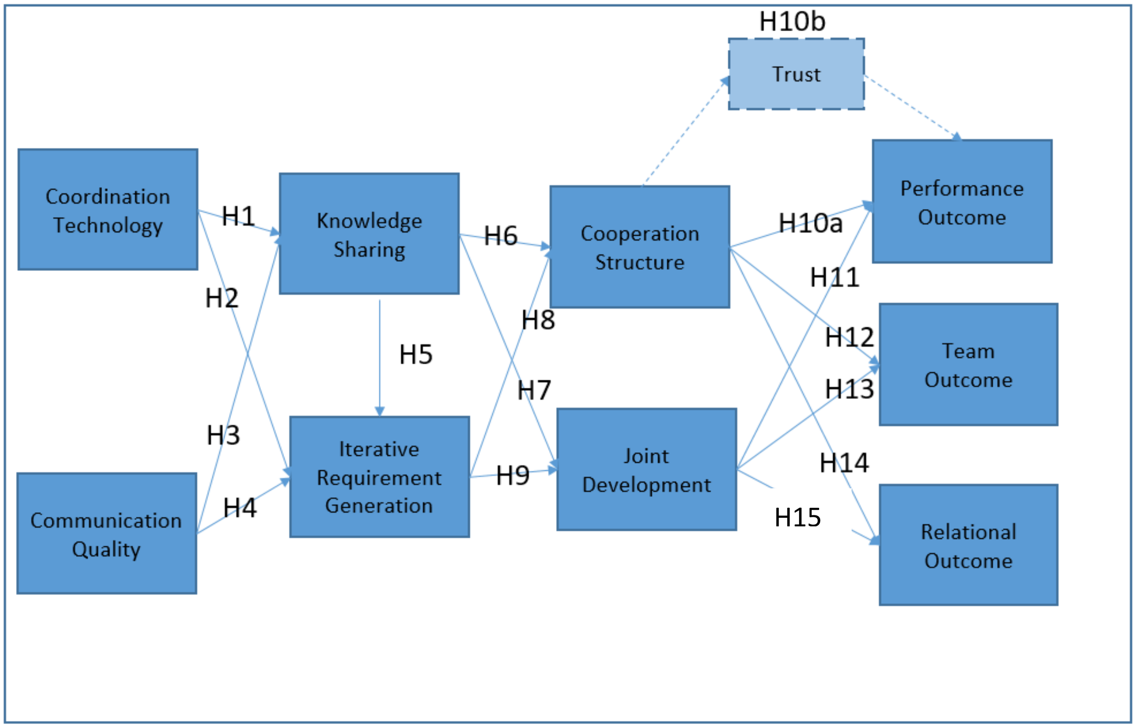
[1] The decisive reasons for conducting mediating but not the moderating test: Theoretically, the key difference between both concepts is that the moderator variable does not depend on the exogenous

Figure 1: Research Model



3.1 Core Constructs of IT Development Collaboration

There are two major constructs of IT development collaboration: joint development, and cooperation structure. These two constructs co-exist in any IT collaboration behaviors. Joint development focusses on interpersonal problem solving, shared vision and joint pursuit of project objectives; while the joint development activities allow client and vendor to work together to develop and test new product designs

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construct; In contrast, with mediation, there is a direct effect between the exogenous construct and the mediator variable (Hair Jr et al. 2016). However, this direct effect between the exogenous construct (cooperation structure) and the mediator variable (trust) is necessary for this research. Such direct effect supports the existing theory that an effective collaboration can produce trust.
Practically, full meditation and moderation are very similar concepts. Moderation is similar to mediation in that a third variable (a mediator or moderator variable) affects the strength of a relationship between two latent variables (Hair Jr et al. 2016). Thus, considering that the moderation effect also has a theoretical foundation, I included the test report in the appendix.

and technology solutions, cooperation structure provides the Initial and continuous clarity and protection on each party's commitments, roles, responsibilities, expectations, and resource needs. Table 3 summarizes the definitions and the key emphases of the two core constructs.

Construct	**Perspective**	**Definition**
Cooperation Structure	Shared agreements/ rules/ protocols	The agreements the two parties, which provides the initial and continuous clarity on each party's commitments, roles, responsibilities, expectations, and resource needs.
Joint Development	Cooperation behaviors	Joint behavioral patterns of the two parties, which focus on the interpersonal problem solving, shared vision and joint pursuit of project objectives. The Client and vendor work together to develop and test new product designs and technology solutions.

Table 3: Core Constructs of IT Development Collaboration

3.1.1 Cooperation Structure

The construct of cooperation structure is defined as the extent to which clear rules with regard to the two parties' responsibilities, interactions, and idea exchanges during the project are specified and agreed upon between the client and the vendor in the development process. Unlike independent product development activities, which areperformed in a more linear-sequential development enticement, each member performs its task in a separated environment and delivers his output to his co-workers once he finished the task; collaborative project development is a dynamic teamwork process where participants constantly assess their common benefits and desires to adjust their decisions for future collaborative activities

(Smith et al. 1995). Thus, it should be guided by mutual rules and agreements of the two parties to protect the performance of the IT project. Also, in a collaborative IT development environment, product development activities become more interconnected, team members are required to concurrently work on the same tasks. Individual actions and efforts are joined and synthesized into cooperative actions (Barnard 1968). This new structure requires both client and vendor streamlining their shared decision-making structures and manage their cooperation activities simultaneously. To protect the interconnectedness of the IT project, mutual agreements on the initial and continuous clarity on commitments, roles, responsibilities, expectations, and resource are essential.

Unlike contract terms that serve as a formal guidance of a project; cooperation structure is about soft (flexible) and informal mutual rules, agreements and protocols. These rules, agreements and protocols constantly evolve and refine while the two parties constantly participant in cooperative activities such as knowledge-sharing, and requirement design. Their teamwork experience and evolving clarification of their mutual objectives and shared goals help them refine the existing cooperation structures. These structures may or may not be formally documented and could be revised or improved over time through negotiations. However, it is the core controlling structure of project collaboration that serves as the guiding principles of all joint activities, such as shared decision making, shared work duties, and other cooperation activities required working with clients (Gulati et al. 2012). Interactive IT development processes such as knowledge-sharing and iterative requirement generation are expected to improve or reshape the cooperation structures. Through constant and frequent knowledge-sharing and task interactions, client and vendor can expect to reach or improve their mutual agreement and develop common goals toward future cooperation tasks.

3.1.2 Joint Development

Joint development is defined as the extent to which the vendor team and the client team work together in the development process with regard to software design and new technology practice development. Joint development presents the interaction patterns of the two parties. The construct extends Heide's concept of joint action - the degree of interpenetration of organizational boundaries (Heide and John 1990). Joint development behavior requires the client and the vendor work together to develop and test new product designs and technology solutions. The two parties need to carrying out the major project activities in a cooperative or coordinated way; the boundaries of the two parties have been penetrated by the integration of activities (Heide and John 1990). The client becomes involved in activities that are traditionally considered the vendor's responsibility and vice versa (Heide and John 1990).

In the IT development context, we define these boundary-spanning cooperative activities as joint development. Joint development behaviors occur through the interaction and collaboration of the two parties during product design and development cycles. The construct focuses on the behavioral patterns of cooperative activities such as interpersonal problem solving, shared vision and joint pursuit of project objectives. It is the generalization of cooperation activities which enabled by IT development and coordination processes such as communication, knowledge-sharing, and iterative requirement generation. The active usage of interactive IT development processes stimulate the joint actions of the two parties and allow them to work together to develop and test new product designs and technology solutions. Thus, knowledge-sharing and iterative requirement generation processes are expected to encourage the joint responses from the two parties to the new product development and further enable continuous feedback cycles.

3.2 Coordination and IT Development Processes and Technologies

Interactive IT development processes and technologies are defined as the generalization of IT development, design, and coordination practices and technologies. The following core project practices and technologies that serve the purpose of IT project interactions have been identified: (1) coordination technology, (2) communication, (3) knowledge-sharing, and (4) iterative requirement generation.

In an IT development context, coordination and IT development processes and technologies have been used to serve the purpose of creating or engaging collaborative behaviors. These practices have been promoted and used as the mediums to encourage frequent information sharing and feedback gathering of the two parties, which could potentially produce collaboration (Hoda et al. 2011). Table 4 summarizes the key practices and technologies involved in IT development and project coordination.

Constructs	Type of Processes	Definition
Coordination Technology	Coordination Processes (supporting role)	The extent to which coordination tools are available by which the client can access, monitor, evaluate, and coordinate the vendor team's development process.
Communication	Coordination Processes (supporting role)	The extent to which the vendor and the client team exchange information on a timely, sufficient, proactive, and effective manner.
Knowledge-sharing	Development Processes (direct engagement)	The extent to which the development process enables the vendor team to acquire from and share with the client technical and business know-how and domain expertise that are needed for successful project completion.
Iterative Requirement Generation	Development Processes (direct engagement)	The extent to which the development process allows the vendor and the client team to improve software product through continual refinement and modification, and repeated customization of work-in-progress software.

Table 4: Summary of Development Processes and Technologies

3.2.1 Coordination Practices and Technologies

As a result of the large amount of costs associated with IT project collaboration, some project teams prefer to structure their project coordination procedures through coordination tools for the purpose of supporting IT development processes. In the IT project development context, because of the focus of product development, the client is only able to evaluate project progress at the end of each development iteration, and to provide feedback and new requirements based on the demonstrations provided by the IT vendor. Thus, within each iteration, IT development tasks and working progress are not entirely visible or accessible to the clients. The lack of task progress information can cause performance ambiguity. When project collaboration is based on the ability to observe the other party's actions and to respond to them, performance ambiguity can make collaborative tasks more difficult (Heide and Miner 1992). Thus, building a remotely visible coordination environment is the primary expectation for collaborative projects. There are two kinds of understanding regarding the importance of coordination. Some technology researchers argue that tools and techniques make the critical differences (Guinan et al. 1998; Williams et al. 2011), whereas the behavioral researchers suggest that interpersonal relationship and interpersonal interactions determine success (Ancona and Caldwell 1992; Jassawalla 2003; Smolander et al. 2016). However, no one would argue that either perspective is complet by itself (Guinan et al. 1998). To achieve a more compressive understanding of coordination, we conceptualize coordination activities and practices from both the technological perspective (coordination technology) and the behavioral perspective (communication).

In our research context, coordination technology can be defined as the extent to which coordination tools are available by which the client can access, monitor, evaluate, and coordinate the vendor team's development processes. A major role of coordination technology is to coordinate various activities both externally with clients and internally within the development team (Ancona and Caldwell 1992). Coordination technology can support the interactions of multiple stockholders and can enable the connections with clients. It emphasizes the enabling and supporting role of project coordination tools and helps the client evaluate the vendor's project progress through coordination tools. By using coordination tools, two parties can discover their misunderstandings, and enable information transparency between both sides (client and vendor). Coordination technology also helps both the client and the vendor to resolve issues related to interdependent schedules. When the two parties working on activities require frequent information exchanges in activities such as system design and product requirement generation, the capability of coordinating interdependent tasks is essential. Previous studies suggest that product teams can perform poorly with respect to budgets and schedules with insufficient task coordination, even if the team has acquired adequate information and communicated frequently with external members (Ancona and Caldwell 1992). Therefore, we propose:

H1: The usage of coordination technology is positively associated with knowledge-sharing.

H2: The usage of coordination technology is positively associated with iterative requirement generation.

3.2.2 Communication Quality

Communication quality refers to the extent to which the vendor team and the client team exchange information on a timely, sufficient, proactive, and effective manner. It represents the behaviorists' perspective of coordination activities. It is also the most basic and the most fundamental coordination practices (Jain and Suman 2015). The project team needs to constantly communicate with the client to confirm project designs and to coordinate project-related problems to deal with design ambiguities. Communication with clients is operationalized in terms of the extent to which the client and vendor (a) timely exchange information (b) effectively exchange information, (c) efficiently exchange information and (d) informally exchange information. Clients' involvement and collaboration opportunity always begin with communications. Through frequent communications, the client will have a much clear understanding of the ongoing project. Effective communication may support constant knowledge-sharing and team learning (Vidgen and Wang 2009). Communicating with the client clearly, honestly, and timely is necessary to gain client's trust and to keep the project on schedule. Therefore, we propose

H3: The quality of communication is positively associated with knowledge-sharing.

H4: The quality of communication is positively associated with iterative requirement generation.

3.2.3 IT Development Processes - Knowledge-sharing

Knowledge-sharing is defined as the extent to which the development process enables the two parties to acquire and share technical and business know-how and domain expertise with each other. Knowledge-sharing behaviors can increase the quantity and the quality of ideas, increase the quality of problem-solving and speed up the problem-solving process (Sheremata). It benefits the client and the vendor by increasing the opportunities to discover and identify new IT and business requirements for their IT project. In today's highly dynamic market situations, an innovative IT design requirement at the beginning of the project may become obsolete during the project. Frequent knowledge-sharing and exchange between the two parties could help the project stakeholders adjust their product requirements and incorporate new ideas and domain knowledge during the development process, which could enhance the vendor's market knowledge and thus its innovation efforts (Blazevic and Lievens 2008). Therefore, we propose:

H5: Knowledge-sharing behaviors are positively associated with iterative requirement generation.

H6: Knowledge-sharing behaviors are positively associated with cooperation structure.

H7: Knowledge-sharing behaviors are positively associated with joint development behaviors.

3.2.4 IT Development Processes - Iterative Requirement Generation

Iterative requirement generation is defined as the extent to which the development process allows the vendor and the client team to improve and create product requirements through continual refinement, modification, and repeated customization of work-in-progress software. Product requirements represent the most significant sources of changes that a development team will encounter and must continue to respond to (Vidgen and Wang 2009). The process of iterative requirement development focuses on the repeated customization and continuous modifications of the work-in-progress IT system.

Iterative requirement generation is the process to customize the working-in-progress IT system incrementally, to adopt new ideas and new requirements iteratively, and to collect feedbacks jointly. The core value of the iterative design is to maximum the feasibility of product customization through the continual engagements and involvements of all the stakeholders and continuous feedback loops from all the stakeholders. Thus, the process itself offers a channel for project collaboration. In the whole iterative requirement generation process, the development team needs to continuously cooperate with the client and to offer product demonstrations to them at each development iteration to collect feedbacks and new suggestions. There are two main benefits of iterative requirement generation. (1) The process could help the client understand their development requirements accurately. If the client decides that the product requirements need to be changed, they could team up with the vendor team for the development of new requirements and the modification of the existing designs. Such activities usually run incrementally; the process can iteratively generate new requirements and implement them in the next iteration. (2) Iterative product customization offers not only a better collaboration channel to the client, but also the client the chance to evaluate and reconsider their IT requirements and to offer timely feedback to the development team. Iterative requirement planning is short-term based which allows the development requirements to be continually adjusted by the project stakeholders after each iteration.

The process of iterative requirement generation focuses on the feedback loops of requirement design and creates anticipated future interaction opportunities, which offer great benefits to product customization. Product customization is one important potential technical source to produce interdependent work relationship and could enhance the chances of cooperation (Barnett and Carroll 1987). Highly customized products may generate more direct information-sharing requirements, which produce cooperative patterns and behaviors (Heide and Miner 1992). Product development is a highly uncertain and complex task. Most of the product development interactions are not clearly programmed in standard operating procedures and routines but evolve to meet task demands (Ancona and Caldwell 1992). Therefore, we propose:

H8: The usage of iterative requirement generation process is positively related to cooperation structure.

H9: The usage of Iterative requirement generation process is positively related to joint development behaviors.

3.3 Trust

Trust is defined as a situation in which a trustor develops enough confidence in a target's motives and future behaviors to be willing to rely on that target in a situation that is potentially risky for the trustor (Doney et al. 1998; McAllister 1995). According to previous research on trust development, trust building can be conceptualized through the following two facets (1) trust as a set of beliefs or expectations and (2) trust as a willingness to act on those beliefs. Thus, we follow this conceptualization and define trust building construct as the extent to which the vendor team and the client believe and expect that the two parties will care for and act based on the other party’s interests and needs even in the absence of active monitoring. In a trusting situation, the trustors engage in one or more cognitive-behavioral processes to determine whether or not the targets are trustworthy (Doney et al. 1998). In our research setting, the following trust building behaviors have been identified: (1) Calculative Trust: The trustor calculates the costs and the rewards of a target acting in an untrustworthy way; (2) Prediction Trust: The trustor develops confidence that a target's behavior can be predicted; (3) Intentionality Trust: The trustor evaluates a target's motivations; (4) Capability Trust: The trustor assesses a target's ability to fulfill his or her promises; (5) Transference Trust: The trustor draws on proof sources from which trust is transferred to a target (Doney et al. 1998; Poppo et al. 2015; Rustagi et al. 2008).

Client trust is essential for ensuring quality and success of IT development collaboration. If the two parties need to benefit from each other, it is required that they trust each other and appear mutually trustworthy. Clients need to trust their vendors with regard to desired quality and timing of service delivery and non-display of opportunistic behavior that might lead to loss of control over the outsourced activity (Kedia and Lahiri 2007). However, the influence of trust on the client-vendor relationship has not been studied adequately (Gainey and Klaas 2003; Kedia and Lahiri 2007; Langfield-Smith and Smith 2003).

Previous studies on trust building show that, among all determinants, trust has the strongest positive effect on decision sharing, mutual agreement, and commitment (Chen et al. 2011; Doney et al. 1998). To reduce the chance of opportunism and lower transaction costs, some elements of trust are required for any transaction in which simultaneous information exchange is unavailable to the parties (Ring and Van de Ven 1992). In other words, trust is required if the two parties need to work together and to believe each other. Thus, the formation of trust is grounded on the expectation that both sides tend to commit to their roles while exhibiting fair and faithful behaviors and care for each other's welfare, which is long-term in nature and has the high potential of creating value (Das and Teng 2001; Krause 1999).

3.4 Outcomes of IT Project Collaboration

The outcomes of project collaboration are mutual between the two parties in terms of benefits, including both (2) project outcomes and (2) emerging outcomes. The traditional project performance outcomes have been constructed to assess schedule, budget, and functionality, the emerging outcomes have been constructed to assess vendor’s emerging and long-term developmental effort, such as team cultivation, new practice adoption and relationship maintenance and bonding. These emerging outcomes are noneconomic in nature and focus mainly on the IT vendor’s effort to growth and mature.

3.4.1 Project Performance Outcomes

Project performance has been conceptualized as a multidimensional construct that includes facets such as effectiveness and efficiency (Hoegl and Wagner 2005). The efficiency facet of outcome has been defined in terms of the adherence to the original development schedule, while effectiveness facets have been defined in terms of the degree to which expectations regarding development quality (such project scope, stability) and product budgets are met (Hoegl and Wagner 2005;

Lee and Xia 2010). The multidimensional perspectives of project performance outcomes are more consistent with the understanding of practitioners, who need to meet and balance multiple objectives in product development projects (Hoegl and Wagner 2005; Lee and Xia 2010; Mao et al. 2008). Joint development behaviors have been found to have positive relationships with adherence to product quality, adherence to product cost targets, adherence to development budgets, and adherence to development schedules (Gulati et al. 2012; Hoegl and Wagner 2005). We conceptualize the results of these positive relationships as the performance outcome of IT development projects. Therefore, we propose:

H10a: Cooperation structure is positively related to project performance outcome.

H10b[2]: Trust mediates the effect of cooperation structure on project performance outcome.

H11: Joint development is positively related to project performance outcome.

3.4.2 Emerging Outcomes

The Emerging outcomes are mutual benefits in nature, including both team cultivation, and relationship maintenance and bonding. (1) The team (cultivation) outcomes are defined as the extent to which the vendor team has improved its own organizational and development process with regard to IT development

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[2] The mediating effect of trust is proposed as hypothesis 10a's supporting assumption. Trust represents a mechanism that underlies the relationship between cooperation structure and performance outcomes. Cooperation structure leads to trust, and trust in turn leads to performance outcomes. In other words, the mediating effect of trust offers a comprehensive interpretation of an alternate case scenarios. — If cooperation structure does not lead to project performance, what mechanism caused such a situation?

technologies and business domain understanding during a project. (2) The relational outcomes are defined as the extent to which the vendor team has improved its associations with the clients and its ability to work with clients during a project.

While collaboration can play a critical role in the production of new institutions and can diffuse them inter-organizationally, these new institutional effects, such as improved practices, new technologies, enhanced rules and improved client relationship are difficult to undetermined in a short period of time. These new institutions, which were produced through the activities of a project collaboration may not be observable in a short period of time. They are narrowly diffused and are only weakly entrenched but have the potential to become widely institutionalized (Lawrence et al. 2002). Such a phenomenon has been defined as proto-institutions. In other words, while these new practices, technology rules and improved client relationship are not diffused in a large scale, they have the potential to be fully institutionalized in the future if the organization offers enough time and support. Table 5 summarizes the emerging outcomes of the IT project collaboration.

Emerging outcomes	
Team (cultivation) outcomes	Team (cultivation) outcomes are defined as new practices, technologies, or rules that have improved or diffused through the IS project. The outcomes of team development is measured from the generation of new practices, rules, and technologies.
Relational outcomes	Relational outcomes are defined as the new relationship structures, or new project association structures which have been constructed through project collaboration.

Table 5: Summary of Emerging outcomes

Therefore, we propose:

H12: Cooperation structure is positively related to team development outcome of the project.

H13: Joint development is positively related to team (cultivation) outcome of the project.

H14: Cooperation structure is positively related to relational outcome of the project.

H15: Joint development is positively related to relational outcome of the project.

3.5 The Contextual Influence

Since the 1980s, there has been a dramatic increase in the frequency with which companies enter into collaborative relationships (Gulati et al. 2012). Clients increasingly rely on IT vendors to execute works central to their success (Gulati et al. 2012). Under the collaborative relationship, the traditional project development and management logics, such as project control, hierarchy or formal roles based on team climate, and financial incentives are less powerful (Lakhani et al. 2012). Thus, there is a need to reevaluate these project management logics. We define these external management logics outside the control of the development team as project context. In this research, we focus on two major types of project context: (1) team culture, and (2) project control.

(1) We conceptualize collaborative team culture as a collaborative climate in which the client and the vendor team can engage in more joint development activities.

Cooperative behaviors cannot be mandated by either side but rather depend on both parties' willingness to cooperate in joint activities (Selnes and Sallis 2003). To promote such joint activities, management can cultivate a collaborative culture within the team (Selnes and Sallis 2003). Team culture is often derived from an external influence which usually originates from the organization's cultural climate. Project teams with a more collaborative culture are expected to advocate shared decision making, collaborative problem-solving, mutual respect and mutual trust behaviors. Members in such a culture climate are expected to pursue morale and commitment (Cameron and Quinn 2005). Previous studies by Gopal, (2003) and Dey (2010) provided guidance in developing the items (Dey et al. 2010; Gopal et al. 2003).

(2) In this research, project control is conceptualized from the perspective of the client. Based on this study's context, two control mechanisms will be used. Client behavioral control is defined as the extent to which the client expects, assesses, monitors and regulates how the vendor team follows agreed upon procedures. Client outcome control is defined as the extent to which the client manages the vendor team's achievement of project goals by emphasizing and evaluating project goal- and target-related performance. It is a performance evaluation strategy for governing the project team.

CHAPTER 4

4. RESEARCH METHODOLOGY

A combination of qualitative and quantitative methodologies were used in this research. Qualitative field studies were conducted to gain an understanding of the practical challenges, to validate our research model, and to develop the survey instrument. Quantitative survey data were collected and statistical methods were employed to test the theoretical model derived from literature review and field studies (Lee 1991; Spears and Barki 2010). Based on extended literature review and preliminary field studies, we identified the key project collaboration activities and behavioral patterns and used the findings to develop the research model. We adopted quantitative research methods to validate the research model and assess its generalizability.

4.1 Four-phase research process

A four-phase process was adopted for the purpose of our research design (Xia and Lee 2003). The four phases were (1) conceptual development and initial item generation, (2) conceptual refinement and item modification, (3) survey data collection, and (4) data analysis, measurement validation and research model testing. Table summarizes the four phases of the research process.

Phase 1 Conceptual Development and Initial Item Generation	
Literature Review	To develop a more profound understanding of the linkage between theory and existing relevant research models and measurements

Interviews	exploring new measures and relationships about the phenomenon
Qualitative Data Analysis	To generate new and clearer measurements
Item Selection/Creation	Developing new items or adapting existing measurements
Phase 2-Conceptual Refinement and Item Modification	
Sorting procedure	Assess the face validity and the construct validity of the initial items (Moore and Benbasat 1991)
Questionnaire Translation, Editing and Back Translation	To assure the accuracy exchange of the information.
Pilot test	To further validate the relevance, coverage, and clarity of the measurement items (Xia and Lee 2003)
Finalizing items	Final items for the measures
Phase 3-Data Collection	
Online survey	Data collection using online, word and pdf survey
Phase 4-Data Analysis and Measurement Validation	
Data Screening and Descriptive Analysis	Removing incomplete survey responses
Validation	Common Method Bias assessment, Minimum Sample Size Requirements assessment, Reliability, Discriminant and Convergent Validity (Hair Jr et al. 2016)
Result Reporting	Path coefficients, Mediating Analysis, R2, F2, Indirect Effects, Total Effect (Hair Jr et al. 2016)

Table 6: Four-phase research process

4.2 Phase 1: Conceptual Development and Initial Item Generation

The conceptual framework was developed based on the literature review and field studies to understand the key facets of IT project collaboration. Then, qualitative data analysis methods were used to generate an initial pool of measurement items for the focal constructs. A literature review was also conducted to develop a greater understanding of the linkages between theory and the empirical phenomenon. The focus of our study is on the understanding of the empirical phenomenon — the relationships among the focal constructs. Thus, whenever possible, we adapted appropriate measures in the literature. We develop measures for assessing constructs that didn't have existing measures reported in the extant literature.

Literature review and field interviews with 16 IT project managers and senior executives were conducted for the purpose of developing new measures for such contructs as cooperation structure, joint development, and iterative requirements generation. All the measures were developed and improved iteratively through literature review and qualitative analysis of the field studies.

4.3 Phase 2: Conceptual Refinement and Item Modification

Once the framework and initial items were developed and modified; a sorting procedure and two rounds of pilot tests were conducted, which are discussed below.

4.3.1 Sorting procedure

A sorting procedure was used to qualitatively assess the face validity and the construct validity of the initial items (Moore and Benbasat 1991). Five rounds of Q-Sorting validation tests were conducted to improve face and construct validity of the measures. A test is judged to have face validity if it appear to measure what it is supposed to measure (Goodwin 2009). Content validity refers to the extent to which a measure represents all facets of a given construct, which requires the use of recognized subject matter experts to evaluate whether or not the test items assess defined content (Goodwin 2009). For example, a depression scale may lack content validity if it only assesses the affective dimension of depression but fails to take into account the behavioral dimension (Pennington 2003).

The following procedure was used for the Q-sorting:

- Each item in the initial pool was printed on an index card.
- In the sorting procedure, each judge carefully read the card and placed it in one of the places that represent the various constructs.
- An additional category, "too ambiguous/unclear," was included for the judges to put a card into it if they felt it did not belong to any of the predefined construct categories.
- Prior to actually sorting the cards, the judges were explained about the q-sorting process and did a practice run using a simplified set of example measures.

- After the practice run, the judge performed the sorting procedure with the measures for this study.
- After completing the sorting procedure, researchers explained why they sorted cards (if any) into the "too ambiguous/unclear" category and explained why some of the measures were placed into categories other than their intended categories.

At the end of the each sorting, improvements were made to the measures before the next round of sorting. As a result of this iterative sorting procedure, some items were dropped, modified or added to improve face and construct validity.

4.3.2 Pilot Test

The purpose of the pilot test was to further validate the relevance, coverage, and clarity of the measurement items (Xia and Lee 2003). The pilot test was essential to make sure that the survey was effective in getting the desirable quality data (Converse and Presser 1986). Two rounds of pilot tests were conducted through individual interviews with six project managers.

The procedures of the pilot test were:

- The pilot test participants first filled out a questionnaire regarding the importance and relevance of each measure to the corresponding construct.
- They were asked to identify items that appeared to be inappropriate or irrelevant to the constructs.

- Participants also made suggestions for improving the relevance, coverage, understandability, and clarity of the items.
- The pilot testing were conducted through an iterative process. Modifications to the measures were made based a pilot test interview with a project manager before conducting interview with the next project manager. Based on the iterative improvements of the pilot tests with six project managers, the measures were finalized and used in the survey data collection.

Table summarizes the consrcts, their corresponding measures,and key references.

Variables	**Items**	**Key References**
Cooperative Structure (The extent to which clear rules are specified and agreed upon between the client and the vendor in the development process with regard to the two parties' responsibilities, interactions, and idea exchanges during the project.)	1. We have clearly agreed upon rules for specifying the responsibilities between our team and the client's.	(Gulati et al. 2012; Hoegl and Wagner 2005; Koh et al. 2004; Lengnick-Hall 1996; Li and Atuahene-Gima 2001)
	2. We have clearly agreed upon rules for how to make shared decision with our client.	
	3. We have clearly agreed upon rules for how to manage task interdependency with our client.	
	4. We have clearly agreed upon rules for responding to our client's change requests.	
Joint Development (The extent to which the vendor and the client team work together in the development process with regard to software design and new technology practices.)	1. Our development process allows our team to work together with our client to propose new/alternative development solutions.	(Heide and John 1990; Zhang and Bartol 2010)
	2. Our development process allows our team to work together with our client to incorporate new software technologies.	
	3. Our development process allows our team to work together with our	

	client for adopting new development methodologies/practices.	
	4. Our development process allows our client to work together with us in the entire software development cycles.	
Iterative Requirements Generation (The extent to which the development process allows the vendor and the client team to improve software product through continual refinement and modification, and repeated customization of work-in-progress software).	1. Our development process enables us (client and vendor) to incrementally change and improve the project results through repeated modifications.	new
	2. Our development process enables us (client and vendor) to incrementally evaluate and refine the technical requirements on an ongoing basis.	
	3. Our development process assists our client to incrementally refine and extend their business requirements on an ongoing basis.	
	4. Our development process requires our client to incrementally adjust their business requirements on an ongoing basis.	
Knowledge-sharing The extent to which the development process enables the vendor team to acquire from and share with the client technical and business knowhow and domain expertise that are needed for successful project completion.	1. Our development process requires our client to share their domain expertise with our team members.	(Edmondson 1999; Koh et al. 2004)
	2. Our development process requires our team to share work reports and project documents with our client.	
	3. Our development process requires our team members to frequently seek business know-how from our client.	
	4. Our development process enables people from outside the team to share their development experience and knowledge with us.	
Communication Quality The extent to which the vendor and the client team exchange	1. We exchange information with our client in a timely manner.	(Hoegl and Wagner 2005; Jae-Nam and Young-Gul 1999;
	2. We exchange information with our client sufficiently.	
	3. We exchange information with our client effectively.	

information on a timely, sufficient, proactive, and effective manner.	4. We exchange information with our client beyond the call of duty.	Paulraj et al. 2008)
Coordination Technology The extent to which coordination tools are available by which the client can access, monitor, evaluate, and coordinate the vendor team's development process.	1. The coordination tools we use enable us to resolve task dependencies in the project.	(Guinan et al. 1998)
	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.	
TRUST between our team and client The extent to which the vendor team and the client believe and expect that the two parties will care for and act based on the other party's interests and needs even in the absence of active monitoring.	1. Both parties (our team and the client's) behave honestly in dealing with each other considering the rewards and negative consequence.	(Poppo et al. 2015; Rustagi et al. 2008)
	2. We are truthful with our client all the time.	
	3. Our client believes in our intention and willingness to provide extra resources if needed.	
	4. Our software development capability helps us to win our client' confidence.	
	5. Our successful outsourcing histories with trustworthy organizations help us win our client's faith.	
	6. Our team and client team would help each other whenever there is a need.	
Project outcome	1. Our project was completed on time according to the original schedule.	(Kirsch et al. 2002; Lee and Xia 2010)
	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.	

Team (Cultivation) Outcomes The extent to which, as a part of the project outcomes, the vendor team has improved its own organizational and development process with regard to software development technologies and business domain understanding.	1. In the process of doing the project, our team improved our existing software development processes.	(Lawrence et al. 2002)
	2. In the process of doing the project, our team improved our existing business know-how.	
	3. In the process of doing the project, our team expanded into new business markets.	
	4. In the process of doing the project, our team found new ways to utilize our existing software development processes.	
	5. In the process of doing the project, our team found new ways to utilize our existing business know-how.	
	6. In the process of doing the project, our team found new ways to generate value from our existing business market.	
Relational Outcomes The extent to which, as a part of the project outcomes, the vendor team has improved its associations with the clients and its ability to work with clients.	1. In the process of doing the project, we improved our relationships with our client.	New
	2. In the process of doing the project, we created a new project that was an extension of this project.	
	3. In the process of doing the project, we developed new project opportunities with the client.	
	4. In the process of doing the project, we improved our ability to work with our clients.	
	5. In the process of doing the project, we improved our ability to market ourselves to our clients.	
	6. In the process of doing the project, we improved our ability to help our client innovate.	
Team Culture	1. Our team is a very personal place. It is like an extended family. People seem to share a lot of themselves.	(Cameron and Quinn 2005)
	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.	
Behavior Control from client The extent to which our client expects, assesses, monitors and regulates how the vendor team following agreed upon procedures.	1. Our client expected us to follow an agreed upon written sequence of steps in doing the project.	(Henderson and Lee 1992; Kirsch et al. 2002)
	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.	
Outcome Control from client The extent to which the client manages the vendor team's achievement of project goals by emphasizing and evaluating project goal- and target-related performance.	1. Our client emphasized timely project completion.	(Henderson and Lee 1992; Kirsch et al. 2002)
	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.	

Table 7: Constructs, Measurement Items and Key References

4.4 Phase 3: Survey Data Collections

4.4.1 Sampling

A questionnaire based on the measurement development results was used to collect the large-scale data for testing the conceptual framework.

The following standard suggested by Xia and Lee (Lee and Xia 2010; Xia and Lee 2003) was followed:

- The items were randomly ordered to minimize any biases from the survey method.
- Seven-point Likert scales were used for the item measurement.
- A publicly available online survey system had been utilized for the data collect purpose. Digital files were also prepared for participants who preferred to complete the survey offline.

4.5 Phase 4: Data Analysis, Measurement Validation and Model Testing

Structural equation modeling (SEM) techniques were used for the data analysis, measurement validation and model testing. SEM is currently one of the most prominent statistical analysis techniques. One of the key advantages of SEM is the ability to include latent (unobserved) variables in statistical models (Lowry and Gaskin 2014). It is a class of multivariate techniques that combines aspects of factor analysis and regression, enabling the researcher to simultaneously examine relationships among measured variables and latent variables (Hair Jr et al. 2016). Thus, the researcher may model latent (unobserved) constructs comprised of many indicators (observed variables), each of which is a reflection or a dimension of the latent construct (Lowry and Gaskin 2014). For this study, partial least square-structure equation modeling (PLS-SEM) techniques were used as the analytic method. PLS-SEM estimates coefficients to maximize the explained variance (R2 value) of endogenous variables (Hair Jr et al. 2016).

PLS-SEM has become an increasingly visible method among IS and social science disciplines in recent years (Chin et al. 2003; Hair et al. 2012; Hair Jr et al. 2016). PLS was developed in the 1960s by econometrician Herman Wold (1966) and was later further advanced (Hair Jr et al. 2016). While CB-SEM involves constraints regarding the number of observations and small sample sizes in complex model set-ups (Chin and Newsted 1999; Hu and Bentler 1995); PLS-SEM is based on a series of OLS regressions, which has minimum demands regarding sample size and generally achieves high levels of statistical power (i.e., 100 observations) (Reinartz et al. 2009). PLS-SEM is therefore generally more favorable with its smaller sample sizes and more complex models than other methods (Chin et al. 2003; Hair et al. 2012). According to the Hair's PLS research guidelines (2012), the key reasons for researchers to choose PLS-SEM are: (1) small sample sizes, (2) formative measurement of latent variables, and (3) analysis of non-normal data (Hair et al. 2012). These distinctive methodological features make it an excellent alternative to the previously more popular CB-SEM approach (Hair Jr et al. 2016). The following section is a description of the data analysis procedures. Detailed analysis results will be provided in the next chapter.

4.5.1 Data Analysis Procedures

(1) **Descriptive Statistics:** Descriptive statistics were provided by the researcher. Data screening and project background information were also summarized and reported.

(2) **Data Validation Checks:** Two data validation tests for methods biases were adopted by this research: (1) common method bias assessment and (2) minimum sample size requirements assessment. Common method bias assessment is to assess whether or not a potential common method bias was a significant issue. Minimum sample size requirements determine the minimum required sample size in PLS.

(3) **Model Specification:** The model specification was developed by the researcher. Multivariate measurement was used for this structural model. Using several indicators to measure a single construct improved accuracy of the measurement because the measurement was more likely to represent all the different aspects of the concept. Indicators for all constructs, including communication quality, cooperation structure, coordination technology, iterative requirements generation, joint development, knowledge-sharing, performance outcomes, relational outcomes, team outcomes and trust, were modeled as reflective measures.

(4) **Reliability and Validity:** Internal consistency reliability (Cronbach's alpha, composite reliability), convergent validity (average variance extracted) and discriminant validity were checked for the reflective constructed measurement model (Hair Jr et al. 2016). Before assessing the structural model, researcher was required to initially focus on the measurement models, which allowed the researcher to evaluate the reliability and validity of the construct measures (Churchill Jr 1979; Hair Jr et al. 2016). Adequate construct reliability and validity are critical for multivariate measurement

involving multiple items for measuring a construct. Convergent validity is the extent to which a measure correlates positively with other measures of the same construct. Therefore, the items that are indicators (measures) of a specific reflective construct should converge or share a high proportion of variance (Hair Jr et al. 2016). Discriminant validity is the extent to which a construct is truly distinct from other constructs by empirical standards. Thus, establishing discriminant validity implies that a construct is unique and captures phenomena not represented by other constructs in the model (Hair Jr et al. 2016).

(5) **Structural Model Assessment:** The structural model assessment was performed after the measurement model was validated. We used a data set with 179 valid observations for the PLS-SEM analyses. Key criteria for assessing the structural model in PLS-SEM include: 1) the significance of the path coefficients, 2) the mediating effects, 3) the level of the R2 values, 4) the f2 effect size (Hair Jr et al. 2016).

Key Structural Model Assessment Criteria Summary:

Path Coefficients: The path coefficients represent the hypothesized relationships among the constructs. They capture the relevance of significant relationships, which are crucial for interpreting the results and drawing conclusions since a small coefficient, even though significant, may not warrant managerial attention (Hair Jr et al. 2016). Path coefficients have standardized values approximately between –1 and +1. Estimated path coefficients close to +1 represent strong positive relationships and the opposite for negative values. PLS-SEM does not assume that the data are normally distributed. Thus, parametric significance tests used in regression analyses cannot be applied to test whether coefficients such as outer weights, outer loadings, and path coefficients are significant (Hair Jr et al. 2016).

Mediating Analysis[3]:

Mediation analysis is a statistical method used to help answer the question as to how some causal agent X transmits its effect on Y; A mediator is a construct in a causal chain between two other constructs (Hayes 2013). Mediation occurs when a mediator variable intervenes between two other related constructs. In other words, a change in the exogenous construct causes a change in the mediator variable, which, in turn, results in a change in the endogenous construct in the PLS path model (Lowry and Gaskin 2014). Many PLS path models include mediation effects, but these are usually not explicitly hypothesized and tested (Hair et al. 2012). Theory should be the foundation of empirical analyses, thus only when the possible mediation is theoretically taken into account and also empirically tested can

[3] The relationship of the main model is coordination quality -> IT development processes -> collaboration behaviors -> outcomes. Mediating effects have been designed as a separate test. The real world is a more complex environment than research design. Thus we included an extra mediation test to improve our design's generalizability. However, academic research practices require researcher focus on its core findings, thus the mediating effects is designed as a separate test, Audiences can choose to ignore the supplemental findings and focus on the core model. Reviewers or editors can choose to exclude the results to meet the page/content limitation. However, even if the mediation test is not part of the main assumptions, the statistical analysis methodology still suggest researchers to include the full model for the mediation test as the patch coefficients can be changed without the inclusion of the overall structure. Testing and interpreting the mediation effect offer audiences a deeper knowledge for the condition or possible alternate case scenarios regarding the outcome of collaboration.

the nature of the cause-effect relationship be fully and accurately understood (Hair Jr et al. 2016).

The Coefficient of Determination (R2 Value): Once the full model had been tested, research should assess the predictive power of the model (how well the model explains the total variance in the DVs) (Lowry and Gaskin 2014). The most commonly used measure to evaluate the power of the structural model is the coefficient of determination (R2 value), which is a measure of the model's predictive power and is calculated as the squared correlation between a specific endogenous construct's actual and predicted values.

F2 Effect Size: F2 effect size is used to evaluate whether or not an omitted construct has a substantive impact on the endogenous constructs (Hair Jr et al. 2016). Reporting the F2 effect size is increasingly encouraged by editors and reviewers.

(6) **Total Effect:** We also accessed the total effect of each variable on each of the relevant dependent variables**.** The total effect is the sum of direct and indirect effects. The interpretation of total effects is particularly useful in studies aimed at exploring the differential impacts of several driver constructs (Hair Jr et al. 2016).

CHAPTER 5

5. DATA ANALYSIS AND RESULTS

This chapter discusses data screening, validation check, descriptive data analysis, measurement and structural tests with result reporting.

5.1 Descriptive Statistics

The hypotheses were tested using a final survey sample of one hundred and seventy-nine valid responses from eighty-six companies. This final sample was derived after twenty-three responses with more than 20% incomplete data were dropped from the original sample to improve data quality. The descriptive statistics of the survey sample are provided in Table 6, Table 7, Table 8, Table 9, and Table 10 show.

More than eight industries were coverd in our survey, including education, transportation, finance, insurance, e-commerce, telecom, manufacturing, IT and software application development, life sciences, healthcare, construction, entertainment, and others.

Project Domain			
Domain	Frequency	Percent	Cumulative Percent
Education	18	10.1	10.2
Transportation	4	2.2	12.4
Finance	21	11.7	24.3
Insurance	4	2.2	26.6
E-Commerce	15	8.4	35
Telecom	5	2.8	37.9
Manufacturing	13	7.3	45.2

IT/Application Development	47	26.3	71.8
Life Sciences	1	0.6	72.3
Healthcare	4	2.2	74.6
Construction	2	1.1	75.7
Entertainment	2	1.1	76.8
Other	41	22.9	100
Missing	2	1.1	
Total	179	100	

Table 6: Project Domain

Clients of the sampled projects were located across China, Japan, US, Europe, and other countries. The size of the project team was between1-6 to more than 100 people.

Customer Country			
Country	Frequency	Percent	Cumulative Percent
China	127	70.9	70%
Japan	23	12.8	83%
US	10	5.6	89%
Europe	8	4.6	93%
Australia	2	1.2	95%
Hong Kong	2	1.1	96%
Canada	1	0.6	97%
South America	1	0.6	97%
Others	5	2.8	100%

Table 7: Customer Country

Project Team Size		
Members	Frequency	Percent
1-6	24	14.2%
7-15	58	34.3%
16-30	42	24.9%
31-50	27	16%
51-80	1	0.6%
81-100	4	2.4%
100+	13	7.7%
Total	169	100%

Table 8: Project Team Size

The survey respondents represented different stakeholders of IT projects including IT engineers, data development engineers, test engineers, team leaders, and project managers.

Respondent Position			
Job Position	Frequency	Percent	Cumulative Percent
IT Development Engineer	47	26.30%	26.30%
Data Development Engineer	11	6.10%	32%
Test Engineer	9	5%	37%
Sales and Marketing	6	3.40%	41%
Team Leader	4	2.20%	40%
Project Manager	33	18.40%	61%
Senior IT Development Engineer	6	3.40%	65%
Department Manager	26	14.50%	79%
Senior Management	13	7.30%	87%
Others	24	13.40%	100%
Total	179	100	

Table 9: Respondent Position

The majority of the projects (82%) were completed or expected to complete within a year. Approximately 11% of the projects were completed or planned to complete within three years. Fewer than 6% of the projects were longer than three years or without an ending date.

Project Schedules			
Days	Frequency	Percent	Cumulative Percent
Unknown	31	17.3	17.3
0-90	54	30.2	47.5
91-180	29	16.2	63.7
181-365	33	18.4	82.1
366-548	17	9.5	91.6
549-730	3	1.7	93.3
731-1095	2	1.1	94.4
1095+	5	2.8	97.2
Long Terms	5	2.8	100
Total	179	100	

Table 10: Project Schedules

5.2 Common Method Bias

To assess whether or not potential common method bias was a significant issue, we performed Harman's one-factor assessment on all latent constructs (Malhotra et al. 2006; Podsakoff and Organ 1986). We examined the exploratory, unrotated factor analysis to find the results of Harman's single-factor test for all first-order constructs using SPSS. The aim of the test was to determine if a single factor emerged that explained the majority of the variance in the model (Lowry and Gaskin 2014). If so, the common method bias probably occurred on a significant level. Results showed that multiple factors were present and the most covariance explained by one factor was only 38.7%, indicating that common method biases were not likely to be a serious concern (less than the 50% threshold) (Podsakoff and Organ 1986). This suggested that our data did not suffer from the common methods bias.

5.3 Minimum Sample Size Requirements

One commonly used ten times rule (Barclay et al. 1995) was used for determining the minimum required sample size in PLS. The sample size should be equal to the larger of 10 times the greatest number of formative indicators used to measure a single construct, or 10 times the greatest number of structural paths directed at a particular construct in the structural model (Hair Jr et al. 2016). This research also followed the rules provided by Cohen (1992) which takes both statistical power and effect sizes into account (Cohen 1992). When the maximum number of independent variables in the measurement and structural models are five, one would need forty-five observations to achieve a statistical power of 80% for detecting R2 values of at least 0.25 with a 5% probability of error (Hair Jr et al. 2016). Thus, our 202 samples (179 valid samples) met the minimum sample size requirements.

5.4 Reliability and Validity

Assessment of reflective measurement models involves determining indicator reliability (squared standardized outer loadings), internal consistency reliability (composite reliability), convergent validity (average variance extracted, AVE), and discriminant validity (Fornell-Larcker criterion, cross-loadings) (Hair et al. 2012).

5.4.1 Internal consistency reliability

The first criterion to be assessed is internal consistency reliability (Hair Jr et al. 2016). Internal consistency reliability (ICR) indicates how well the indicators of a reflective construct measure that construct. It is assessed by the correlation between the indicators of the reflective measures alpha (MacKenzie et al. 2011), which provides an estimate of the reliability based on the inter-correlations of the observed indicator variables (Hair Jr et al. 2016).

There are two assessments for the internal consistency reliability: (1) Cronbach's alpha and (2) composite reliability. Cronbach's alpha is sensitive to the number of indicators, shows a conservative value for measuring reliability, and tends to underestimate the internal consistency reliability, as compared to composite reliability (Hair Jr et al. 2016). Due to Cronbach's alpha's limitations, it is technically more appropriate to use a different measure of internal consistency reliability, which is referred to as composite reliability (Hair Jr et al. 2016). While Cronbach's alpha assumes that all indicators are equally reliable (all the indicators have equal outer loadings on the construct), composite reliability takes into account the different outer loadings of the indicator variables (Hair Jr et al. 2016). Cronbach's alpha is a conservative measure of reliability; in contrast, composite reliability tends to overestimate the internal consistency reliability, thereby resulting in comparatively higher reliability estimates (Hair Jr et al. 2016).

Given the purpose of our research, we followed Hair's (2016) guideline and reported both criteria. Internal consistency reliability values below 0.60 indicate a lack of internal consistency reliability. The recommended threshold of 0.70 can be regarded as satisfactory (Chin 1998b). Each reflective construct in our research model demonstrated a level of reliability well above the recommended threshold of 0.70. The results of internal consistency reliability analyses are summarized in Table 11.

Constructs	**Cronbach's Alpha**	**Composite Reliability**
Communication Quality	0.869	0.919
Cooperation Structure	0.854	0.902
Coordination Technology	0.865	0.917
Iterative Requirements Generation	0.858	0.913
Joint Development	0.821	0.883
Knowledge-sharing	0.784	0.874
Performance Outcomes	0.864	0.916
Relational Outcomes	0.819	0.892
Team Outcomes	0.845	0.907
Trust Building	0.838	0.885
Recommended threshold: > 0.70		

Table 11: Summary of Internal Consistency Reliability

5.4.2 Convergent Validity

Convergent validity was established by following the procedures and guidelines established by previous studies (Henseler et al. 2015; Lowry and Gaskin 2014; Straub et al. 2004). We first established convergent validity for the reflective constructs by checking on the outer loadings of all indicators. The outer loadings of all indicators should be statistically significant (Hair Jr et al. 2016; Lowry and

Gaskin 2014). Detailed procedures and results of measurement validation are presented in Table 14 below.

Constructs	**Indicators**	**Item Loading**	**T-Statistics**	**P-Values**
Communication Quality	Com_1	0.884	33.484	0
	Com_2	0.931	83.782	0
	Com_3	0.852	24.741	0
Cooperation Structure	CoopStr_1	0.82	24.724	0
	CoopStr_2	0.857	23.65	0
	CoopStr_3	0.862	24.45	0
	CoopStr_4	0.797	20.539	0
Coordination Technology	CoorTech_1	0.874	31.988	0
	CoorTech_2	0.901	43.55	0
	CoorTech_3	0.887	36.398	0
Iterative Requirements Generation	IterReqiGen_1	0.9	54.375	0
	IterReqiGen_2	0.893	41	0
	IterReqiGen_3	0.853	28.364	0
Joint Development	JointDev_1	0.714	15.506	0
	JointDev_2	0.863	27.537	0
	JointDev_3	0.902	52.948	0
	JointDev_4	0.743	16.768	0
Knowledge-sharing	KnowSharing_1	0.878	38.334	0
	KnowSharing_2	0.846	23.677	0
	KnowSharing_3	0.781	10.188	0
Relational Outcomes	OutRelation_3	0.823	25.975	0
	OutRelation_4	0.857	27.249	0
	OutRelation_5	0.889	42.356	0
Team Outcomes	Outteam_1	0.819	24.95	0
	Outteam_4	0.908	52.574	0
	Outteam_5	0.894	41.332	0
Performance Outcomes	ProjOut_1	0.893	36.374	0
	ProjOut_2	0.895	46.186	0
	ProjOut_3	0.87	36.211	0

Trust	TRUST_1	0.779	20.562	0
	TRUST_2	0.81	20.59	0
	TRUST_4	0.746	14.616	0
	TRUST_5	0.747	14.825	0
	TRUST_6	0.813	23.127	0

Table 12: Outer loadings of all indicators

High outer loadings on a construct indicate the associated indicators have much in common, which is captured by the construct (Hair Jr et al. 2016; Lowry and Gaskin 2014). A common rule of thumb is that the standardized outer loadings should be 0.708 or higher (Hair Jr et al. 2016). The report of Table 12 suggested that all of the outer loadings were significant at the 0.05 level with standardized outer loadings greater than 0.708.

Average Variance Extracted (AVE)

To evaluate convergent validity on the construct level, researchers also need to consider average variance extracted (AVE) (Hair Jr et al. 2016; Lowry and Gaskin 2014). This criterion is defined as the grand mean value of the squared loadings of the indicators associated with the construct (squaring each outer loading, obtaining the sum of the squared outer loadings, and then calculating the average value.). An AVE value of 0.50 or higher indicates that the construct explains more than half of the variance of its indicators (Hair Jr et al. 2016). The results demonstrated in the Table 13 suggested that all the constructs met the criterion by explaining more than half of the variance of its indicators.

Constructs	Average Variance Extracted (AVE)
Communication Quality	0.791
Cooperation Structure	0.696
Coordination Technology	0.787
Iterative Requirements Generation	0.779
Joint Development	0.655
Knowledge-sharing	0.699
Performance Outcomes	0.785
Relational Outcomes	0.734
Team Outcomes	0.764
Trust	0.607
AVE value of 0.50 or higher indicates a satisfied result.	

Table 13: The AVEs of the constructs

5.4.3 Discriminant Validity

To determine the discriminant validity of our indicators, we used three established techniques (Cross Loading, Fornell-Larcker criterion and Heterotrait-monotrait ratio (HTMT)) (Hair Jr et al. 2016; Henseler et al. 2015; Lowry and Gaskin 2014).

5.4.3.1 Cross Loading Assessment

Checking on cross-loadings is typically the first approach to assess the discriminant validity of the indicators. An indicator's outer loading on the associated construct should be greater than any of its cross-loadings (i.e., its correlation) on other constructs; researchers should consider dropping the construct that violates this guideline (Hair Jr et al. 2016; Lowry and Gaskin 2014). Discriminant validity is considered to be adequate if the cross-loadings (with other latent variables) are more than the absolute value of 0.100 distant from the loading on the primary latent variable (Wilson 2002).

Table 14 is a matrix of loadings and cross-loadings for all reflective items that were used to measure the variables included in the research model. According to the cross-loadings approach, strong discriminant validity was established for all items after dropping four items from constructs (com4, IterreqiGen4, OutRelation2 and Trust3). The loadings of the items in the final results were greater for the latent variable to which they theoretically belong than for any other latent variable.

Loadings of the Measurement Items

items	Communication Quality	Cooperative Structure	Coordination Technology	Iterative Requirements Generation	Joint Development	Knowledge Sharing	Performance Outcomes	Relational Outcomes	Team Outcomes	Trust Building
Com_1	0.878	0.544	0.492	0.483	0.335	0.457	0.367	0.368	0.261	0.624
Com_2	0.928	0.577	0.592	0.517	0.364	0.47	0.476	0.396	0.383	0.686
Com_3	0.842	0.51	0.562	0.46	0.411	0.347	0.447	0.383	0.373	0.608
Com_4	0.358	0.22	0.282	0.281	0.289	0.144	0.201	0.291	0.288	0.168
CoopStr_1	0.584	0.82	0.439	0.463	0.368	0.517	0.423	0.332	0.298	0.651
CoopStr_2	0.542	0.857	0.587	0.53	0.44	0.501	0.351	0.394	0.417	0.609
CoopStr_3	0.496	0.862	0.587	0.501	0.388	0.512	0.42	0.386	0.405	0.603
CoopStr_4	0.435	0.796	0.568	0.44	0.382	0.452	0.399	0.403	0.428	0.518
CoorTech_1	0.604	0.567	0.843	0.548	0.437	0.445	0.407	0.468	0.473	0.578
CoorTech_2	0.531	0.582	0.882	0.559	0.433	0.521	0.358	0.368	0.433	0.504
CoorTech_3	0.565	0.622	0.883	0.562	0.555	0.524	0.45	0.468	0.503	0.597
CoorTech_4	0.427	0.448	0.798	0.491	0.358	0.419	0.29	0.364	0.446	0.468
IterReqiGen_1	0.495	0.478	0.497	0.876	0.559	0.641	0.405	0.353	0.389	0.514
IterReqiGen_2	0.491	0.517	0.574	0.845	0.657	0.548	0.454	0.442	0.454	0.476
IterReqiGen_3	0.485	0.554	0.582	0.877	0.524	0.647	0.334	0.423	0.397	0.523
IterReqiGen_4	0.376	0.344	0.431	0.696	0.376	0.469	0.219	0.299	0.269	0.365
JointDev_1	0.478	0.469	0.457	0.51	0.714	0.522	0.38	0.462	0.452	0.574
JointDev_2	0.31	0.374	0.415	0.495	0.863	0.321	0.354	0.505	0.522	0.333
JointDev_3	0.315	0.353	0.43	0.603	0.902	0.377	0.352	0.46	0.477	0.385
JointDev_4	0.268	0.317	0.391	0.482	0.744	0.282	0.315	0.35	0.398	0.277
KnowSharing_1	0.441	0.54	0.508	0.592	0.384	0.878	0.381	0.407	0.436	0.495
KnowSharing_2	0.439	0.544	0.481	0.605	0.371	0.847	0.346	0.379	0.346	0.511
KnowSharing_3	0.323	0.394	0.415	0.562	0.443	0.78	0.415	0.461	0.455	0.416
OutRelation_1	0.367	0.394	0.399	0.387	0.433	0.392	0.506	0.807	0.739	0.331
OutRelation_2	0.28	0.303	0.324	0.275	0.373	0.39	0.434	0.677	0.581	0.297
OutRelation_3	0.476	0.391	0.422	0.433	0.464	0.46	0.422	0.783	0.574	0.49
OutRelation_4	0.247	0.333	0.391	0.355	0.392	0.369	0.436	0.831	0.706	0.288
OutRelation_5	0.372	0.363	0.392	0.369	0.516	0.341	0.389	0.847	0.732	0.359
Outteam_1	0.265	0.289	0.387	0.338	0.531	0.38	0.498	0.712	0.803	0.281
Outteam_2	0.44	0.374	0.442	0.391	0.341	0.542	0.633	0.619	0.767	0.447
Outteam_3	0.311	0.38	0.461	0.406	0.385	0.339	0.474	0.596	0.722	0.348
Outteam_4	0.296	0.394	0.456	0.334	0.528	0.357	0.451	0.736	0.858	0.337
Outteam_5	0.322	0.433	0.452	0.414	0.496	0.384	0.505	0.714	0.862	0.382
ProjOut_1	0.438	0.357	0.366	0.355	0.316	0.385	0.893	0.437	0.486	0.475
ProjOut_2	0.433	0.497	0.413	0.372	0.482	0.399	0.896	0.552	0.605	0.503
ProjOut_3	0.424	0.399	0.399	0.438	0.343	0.42	0.87	0.463	0.569	0.437
TRUST_1	0.625	0.529	0.503	0.481	0.288	0.5	0.408	0.291	0.302	0.761
TRUST_2	0.57	0.492	0.381	0.394	0.367	0.372	0.534	0.343	0.288	0.805
TRUST_3	0.492	0.429	0.45	0.363	0.421	0.342	0.255	0.398	0.337	0.662
TRUST_4	0.55	0.511	0.451	0.427	0.348	0.405	0.314	0.341	0.301	0.765
TRUST_5	0.447	0.649	0.51	0.424	0.37	0.405	0.393	0.341	0.352	0.722
TRUST_6	0.558	0.593	0.556	0.495	0.451	0.535	0.467	0.348	0.405	0.805

Red marked Item removed to improve discriminant validity

Green marked loading is greater than 0.75, Yellow marked loading is greater than 0.70

Table 14: Loadings of the measurement items

5.4.3.1 Fornell-Larcker Criterion

To further establish discriminant validity, we ran a correlation of each variable with the other variables and then compared these correlations to the square root of the AVE for each construct (Fornell and Larcker 1981). The square root of each construct's AVE must be greater than its correlations with other constructs to establish discriminant validity (Hair Jr et al. 2016). The AVE test is expecting to verify that the correlation of the construct with its measurement items should be greater than its correlations with the other constructs (Hair Jr et al. 2016; Lowry and Gaskin 2014).

Table 17 reports that discriminant validity test results through the square root of AVEs (on diagonal). The non-diagonal elements represent the correlations among the latent variables. If the diagonal values are greater than any of the other correlations, then this establishes adequate discriminant validity (Hair Jr et al. 2016). If this threshold is not met, the model will need to be reevaluated to determine if items with either low loadings or high cross-loadings should be dropped in order to increase the AVE or decrease the shared variance with another latent variable (Lowry and Gaskin 2014). The results of the Fornell-Larcker Criterion test shown in Table 15 suggests the constructs discriminated well, the square root of AVE (on the diagonal) of each construct was greater than the correlations with the remaining constructs in the model. The results showed strong discriminant validity for all constructs, further confirming the choices of items.

Discriminant Validity through the Square Root of AVE (on diagonal)										
Constructs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Communication Quality (1)	(0.89)									
Cooperation Structure (2)	0.613	(0.834)								
Coordination Technology (3)	0.626	0.666	(0.887)							
Iterative Requirements Generation (4)	0.54	0.586	0.62	(0.882)						
Joint Development (5)	0.411	0.473	0.537	0.659	(0.809)					
Knowledge-sharing (6)	0.484	0.594	0.561	0.693	0.473	(0.836)				
Performance Outcomes (7)	0.48	0.476	0.457	0.451	0.436	0.452	(0.886)			
Relational Outcomes (8)	0.417	0.425	0.471	0.445	0.539	0.456	0.483	(0.857)		
Team Outcomes (9)	0.312	0.426	0.475	0.421	0.593	0.427	0.554	0.76	(0.874)	
Trust Building (10)	0.71	0.715	0.619	0.569	0.472	0.57	0.548	0.425	0.365	(0.779)

Table 15: Discriminant Validity through the Square Root of AVE

5.4.3.3 Heterotrait-monotrait ratio (HTMT)

Heterotrait-monotrait ratio (HTMT) criteria is a new approach for discriminant validity assessment in variance-based SEM (Hair Jr et al. 2016). The HTMT approach is an estimate of what the true correlation between two constructs would be; it is the mean of all correlations of indicators across constructs measuring different constructs (i.e., the heterotrait-heteromethod correlations) relative to the mean of the average correlations of indicators measuring the same construct (i.e., the monotrait-heteromethod correlations (Hair Jr et al. 2016; Henseler et al. 2015).

The new HTMT criteria is a solution to the critical limitations of cross-loadings and the Fornell-Larcker criterion (Hair Jr et al. 2016). Recent research that critically examined the performance of cross-loadings and the Fornell-Larcker criterion for discriminant validity assessment has found that they have an unacceptably low sensitivity; neither approach reliably detects discriminant validity issues (Henseler et al. 2015).

There are three assessment standards for HTMT: HTMT.85, HTMT.90 and HTMT inference. A correlation between two constructs close to 1 indicates a lack of discriminant validity (Hair Jr et al. 2016; Henseler et al. 2015). HTMT.85 is the most conservative criterion, it provides the best assessment of discriminant validity and has been recommended to be considered as the standard for business research (Voorhees et al. 2016). This means that HTMT.85 can point to discriminant validity problems in research situations in which HTMT.90 and HTMT inference indicate that discriminant validity has been established (Henseler et al. 2015). In contrast, HTMT inference is the most liberal of the three newly proposed approaches. Thus we did not adopt this criterion in this study.

Heterotrait-monotrait ratio (HTMT)										
Constructs	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Communication Quality (1)										
Cooperation Structure (2)	0.71									
Coordination Technology (3)	0.73	0.77								
Iterative Requirements Generation (4)	0.62	0.68	0.72							
Joint Development (5)	0.48	0.56	0.63	0.78						
Knowledge-sharing (6)	0.57	0.72	0.68	0.85	0.59					
Performance Outcomes (7)	0.56	0.55	0.53	0.53	0.51	0.55				
Relational Outcomes (8)	0.49	0.51	0.56	0.53	0.64	0.57	0.57			
Team Outcomes (9)	0.37	0.5	0.56	0.49	0.71	0.53	0.64	0.91		
Trust Building (10)	0.83	0.84	0.73	0.67	0.55	0.7	0.64	0.51	0.43	
Conservative criterion < 0.85										

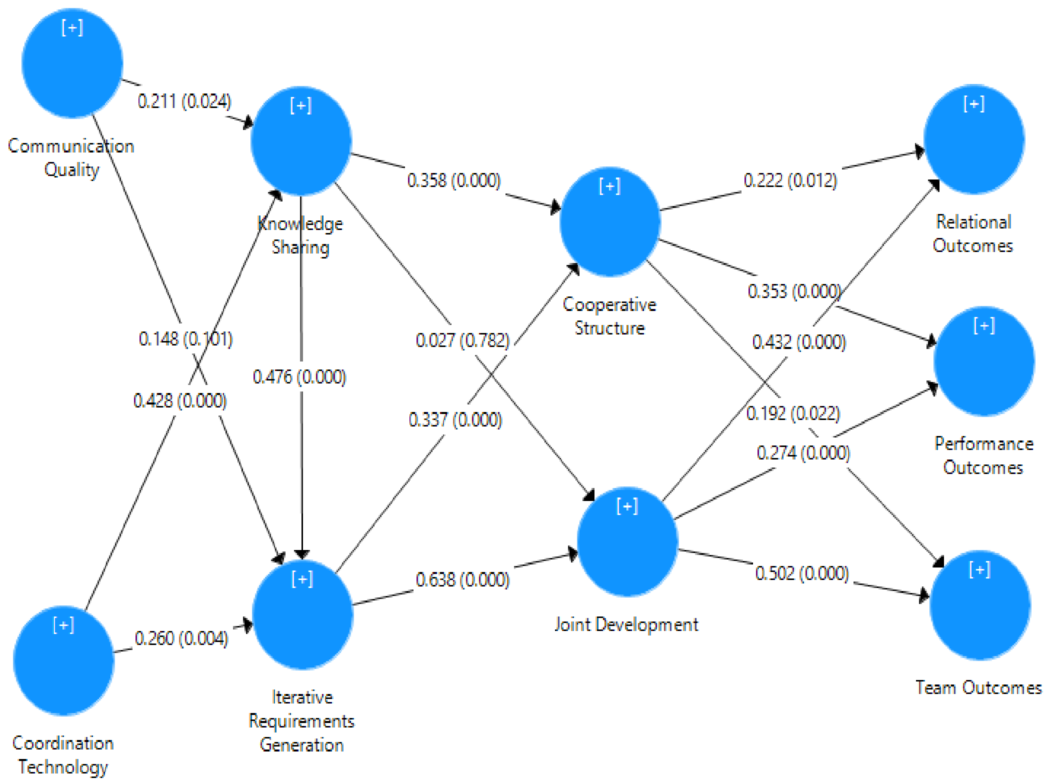
Table 16: Heterotrait-monotrait ratio (HTMT) criteria

As shown in Table 16, the results of the Heterotrait-monotrait ratio (HTMT) assessment showed strong discriminant validity for all constructs except for team outcomes. The team outcomes construct was correlated with relational outcome. However, team outcomes were still close to the less conservative HTMT.90. Also, both the relational outcomes and team outcomes are parts of the emerging outcomes of project collaboration. Thus, it is theoretically related in nature. Moreover, even if two constructs are highly correlated with values close to 1.0, the criterion is unlikely to indicate a lack of discriminant validity, particularly when (1) the loadings are homogeneous and high or (2) the sample size is large (Henseler et al. 2015). Considering the loading of the two constructs are homogeneous and high, we still consider team outcomes to have a reasonable level of discriminant validity.

5.5 Structural Model Assessment - Part 1

The structural model assessment was performed after the measurement model was validated. We used a data set of 179 valid observations for the PLS-SEM analyses. The key criteria for assessing the structural model in PLS-SEM are the significance of the path coefficients, the level of the R2 values, the F2 effect size, and the mediating effects (Hair Jr et al. 2016).

Figure 2: Structural Model 1 (main model)



5.5.1 Structural Model Collinearity

We first checked the structural model for collinearity issues by examining the VIF values of all constructs in the structural model. Structural model collinearity is referred to as having high correlations between two constructs, which can prove problematic from a methodological and interpretational standpoint (Hair Jr et al. 2016). The estimation of structural model path coefficients is based on OLS regressions of each endogenous latent variable on its corresponding predecessor constructs. Thus the path coefficients might be biased if the estimation involves critical levels of collinearity among the constructs (Hair Jr et al. 2016). To assess the level of collinearity, researchers should compute the variance inflation factor (VIF). The term variance inflation factor (VIF) is defined as the reciprocal of the tolerance, which is derived from its square root (VIF) being the degree to which the standard error has been increased due to the presence of collinearity (Hair Jr et al. 2016). In the context of PLS-SEM, a VIF value of 5 and higher indicates a potential collinearity problem (Hair et al. 2011).

Table 17 presents the results of the Structural Model Collinearity Statistic (VIF). All VIF values were clearly below the threshold of 5. Therefore, structural model collinearity is unlikely to be a critical issue in the structural model, and we can continue our data analyses.

Structural Model Collinearity Statistic (VIF)										
Constructs	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Communication Quality (1)						1.65				
Cooperation Structure (2)								1.29	1.29	1.29
Coordination Technology (3)				1.46		1.65				
Iterative Requirements Generation (4)		1.92			1					
Joint Development (5)							1.29	1.29	1.29	1.29
Knowledge-sharing (6)		1.92		1.46						
Performance Outcomes (7)										

Relational Outcomes (8)										
Team Outcomes (9)										
Trust Building (10)							1.29			
Threshold: < 5										

Table 17: Structural Model Collinearity Statistic (VIF)

Structural Model Path Coefficients

PLS-SEM does not assume that the data are normally distributed. Thus parametric significance tests used in regression analyses cannot be applied to test whether coefficients such as outer weights, outer loadings, and path coefficients are significant (Hair Jr et al. 2016). Instead, PLS-SEM relies on a nonparametric bootstrap procedure to test coefficients for their significance (Davison and Hinkley 1997; Efron and Tibshirani 1986). Bootstrap procedure relies on the use of observation samples to make inferences about the population characteristics to estimate the PLS path model and does not make any assumptions about the distribution of the parameters (Sharma and Kim 2013). The number of bootstrap samples must be larger than the number of valid observations in the original data; 5,000 bootstrap samples are recommended (Hair Jr et al. 2016). Thus, the study followed the recommended 5,000 bootstrap samples standard for the purpose of the stability of coefficient estimates. When reporting the significance test results, researchers should provide the t values or the p values (path coefficients with p-values below 0.05 are considered significant) (Hair Jr et al. 2016). For example, path coefficient from coordination technologies to knowledge-sharing was significant, indicating that coordination technology usage has a significant association with knowledge-sharing activities. Table 18 illustrates the path coefficients between the various latent variables and their significance levels (t-statistics, and p-values).

Path Coefficients and Significance Test (main model without mediation)			
Path	Path Coefficients	T Statistics	P Values
Communication Quality -> Iterative Requirements Generation	0.15	1.68	0.09
Communication Quality -> Knowledge-sharing	0.21	2.18	0.03
Cooperation Structure -> Performance Outcomes	0.35	4.83	0
Cooperation Structure -> Relational Outcomes	0.22	2.59	0.01
Cooperation Structure -> Team Outcomes	0.19	2.35	0.02
Coordination Technology -> Iterative Requirements Generation	0.26	2.85	0
Coordination Technology -> Knowledge-sharing	0.43	5.17	0
Iterative Requirements Generation -> Cooperative Structure	0.34	3.52	0
Iterative Requirements Generation -> Joint Development	0.64	8.11	0
Joint Development -> Performance Outcomes	0.27	4.91	0
Joint Development -> Relational Outcomes	0.43	6.21	0
Joint Development -> Team Outcomes	0.5	6.24	0
Knowledge-sharing -> Cooperative Structure	0.36	4.02	0
Knowledge-sharing -> Iterative Requirements Generation	0.48	6.27	0
Knowledge-sharing -> Joint Development	0.03	0.28	0.78
P Values<0.05 means the Path is Significance at 5% significance level			

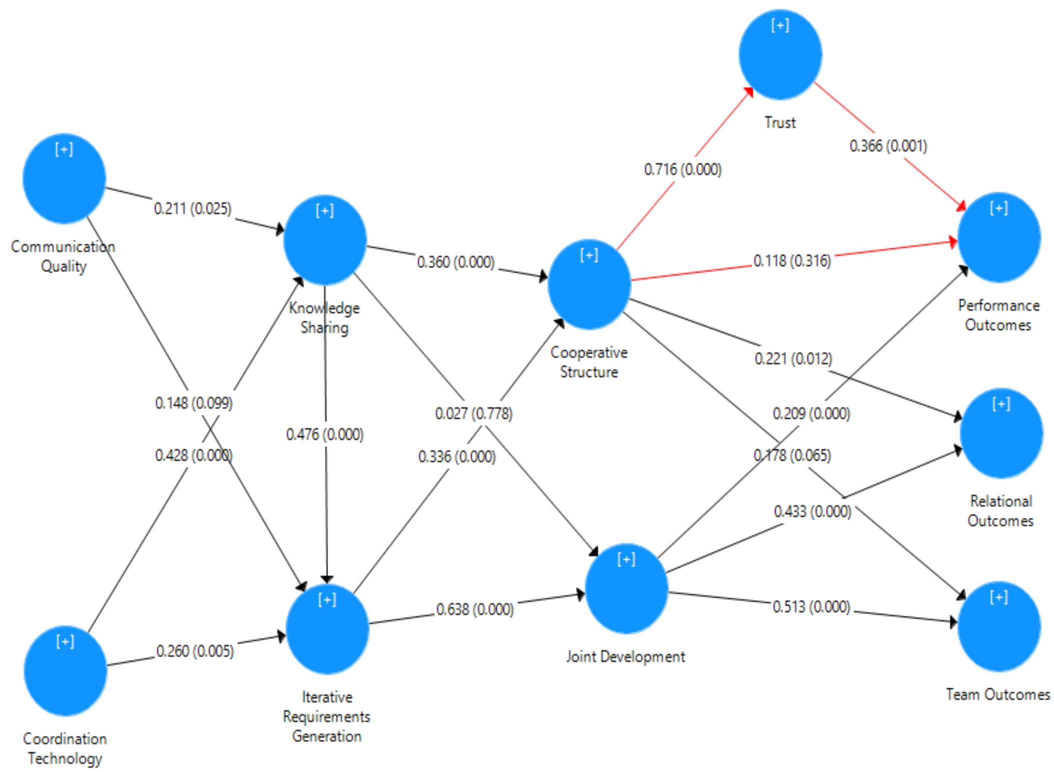
Table 18: Path Coefficients and Significance Test (main model)

As shown in Table 18, assuming a 5% significance level, we found that all relationships in the structural model were significant, except for the paths of communication quality -> iterative requirements generation (p = 0.09), and knowledge-sharing -> joint development (p = 0.78). Coordination technology usage was a critical predictor of knowledge-sharing activities, which in turn was an important predictor of iterative requirements generation. In contrast, communication quality has very little impact on iterative requirements generation process. Cooperation structure had very little effect on team outcomes. In addition, iterative requirements generation was the primary driver for joint development as illustrated by the increased path coefficients compared with those of team competence. Joint development was a key predictive factor of team (cultivation) outcomes.

5.5.2 Mediating Effects

The next step is to test the mediating effect of trust as shown in Table 19. There are two types of mediation effects: partial mediation and full mediation (Baron and Kenny 1986). Partial mediation occurs when the independent variable (IV) still has a significant effect on the dependent variable (DV), but its effect is weakened when the mediator is included in the model. In contrst, full mediation occurs when the IV no longer has a significant effect on the DV when the mediator is included in the model (Lowry and Gaskin 2014).

Table 19 Structural Model 1 (Mediation Effect)



We followed the mediation model analysis procedure suggested by (Hair Jr et al. 2016). The question of how to test mediation has attracted considerable attentions in methodological research over the past decades (Baron and Kenny 1986; Zhao et al. 2010; Hayes. 2013). Prior testing of the significance of mediating effects relied on the Sobel test (Sobel 1982). However, the Sobel test assumes a normal distribution that is not consistent with the nonparametric PLS-SEM method (Hair Jr et al. 2016). In addition, when applied to small sample sizes, the Sobel test exhibits a relatively low statistical power (Hair Jr et al. 2016). Thus, researchers have become less dependent on the Sobel test for evaluating mediation analysis, especially in PLS-SEM studies (Klarner et al. 2013; Sattler et al. 2010). Instead, researchers have increasingly use the bootstrap approach to assess the indirect effects (Preacher and Hayes 2004). The Bootstrapping approach is perfectly suited for the PLS-SEM method since it requires no assumptions about the normal distribution and can be applied to small sample sizes with more confidence (Hair Jr et al. 2016).

First, we need access the significance of the indirect effect of cooperative structure on performance outcomes through trust.

The significance of the indirect effect				
Indirect Paths	Indirect Effect	95% Confidence Intervals of Indirect Effect	T Statistics	P Values
Cooperation Structure -> Trust -> Performance Outcomes	0.23	{0.1， 0.43}	2.69	0.01
P Value < 0.05 indicate a significant indirect path				

Table 20: The significance of the indirect effect of cooperative structure

The results in Table 22 suggested that the indirect effect was since the 95% confidence interval didn’t include zero (Hair Jr et al. 2016). We also reported the t-value and p-value for significance testing. The t-value of the indirect effect (0.23) for the cooperation structure -> performance outcomes relationship through trust was 2.69 with a p-value of 0.01. Please see the appendix for the indirect effects table (Table 39).

We now continue the mediation analysis procedure as shown in Table 21.

The significance of the Direct effect				
	Direct Effect	95% Confidence Intervals of Direct Effect	T Statistics	P Values
Cooperation Structure -> Performance Outcomes	0.12	{-0.14, 0.32}	1.02	0.31
P Value < 0.05 indicate a significant indirect path				

Table 21: The significance of the direct effect

The next step of analysis focused on the significance of the direct effect from cooperation structure to performance outcomes. The relationship from cooperation structure to performance outcomes was weak (0.12) and statistically insignificant ($t = 1.02$; $p=0.31$).

As shown in Table 22, the path coefficient of cooperative structure to performance outcomes became much smaller and insignificant after the mediating variavble trust was added. Following the mediation analysis guideline (Hair Jr et al. 2016), we concluded that trust fully mediated the cooperation structure -> performance outcomes relationship.

Path Coefficients and Significance Test (main model: mediation model comparison)						
Path	Without mediation			With mediation		
	Path Coefficients	T Statistics	P Values	Path Coefficients	T Statistics	P Values
Cooperative Structure -> Performance Outcomes	0.35	4.83	0	0.12	1.01	0.31
P Values<0.05 means the path is Significance						

Table 22: Path Coefficients and Significance Test (mediation model)

Our findings provide empirical support for the mediating role of trust in the structure model. Cooperation structure is of increased importance for trust building. More specifically, trust represents a mechanism that underlies the relationship between cooperation structure and performance outcomes. Cooperation structure leads to trust, and trust, in turn, leads to performance outcomes. We also assessed the mediation effect of trust on joint development to performance outcomes. Considering it is not the focus of the research finding, we presented the analysis report in the Appendices. We also included the path coefficients and significance test report of the mediation model in the Appendices.

5.5.3 Coefficient of Determination (R2 Value)

Both the coefficients of determination and the adjusted coefficients of determination are reported for this research. Chin (1998) suggests that to establish meaningful predictive power of a PLS model, a study needs to show high coefficients of determination (R2 value) and substantial structural paths (Chin 1998a). To be substantial, standardized paths need to be close to 0.20 (and ideally

0.30 or higher) to indicate that the model has meaningful predictive power (Lowry and Gaskin 2014). As with multiple regressions, the adjusted coefficient of determination can also be used as the criterion to avoid bias toward complex models. This criterion is modified according to the number of exogenous constructs relative to the sample size (Hair Jr et al. 2016). Table 23 shows the R-square and R-square adjusted values of the structural models. Base on the above criteria, the results suggested that all constructs had significant coefficients of determination: iterative requirements generation (0.56), trust building (0.53), joint development (0.43), and cooperation structure (0.41).

Coefficient of Determination (R2 Value)		
	R Square	R Square Adjusted
Cooperation Structure	0.41	0.4
Iterative Requirements Generation	0.56	0.55
Joint Development	0.43	0.43
Knowledge-sharing	0.34	0.34
Performance Outcomes	0.34	0.33
Relational Outcomes	0.33	0.32
Team Outcomes	0.38	0.37
Trust	0.53	0.53

Table 23: Coefficient of Determination (R2 Value)

5.5.4 F2 Effect Size

F2 effect size is an assessment that is used to evaluate whether an excluded construct has a substantive impact on the endogenous constructs (Hair Jr et al. 2016). F2 values of 0.02, 0.15 and 0.35 are considered as small, medium, and large respectively; effect size values of less than 0.02 indicates that there is no effect (Cohen 1988).

Table 24 shows the F2 values for all the paths between endogenous constructs and corresponding exogenous constructs. Cooperation structure had a large effect size of 0.67 on trust, had small effect sizes of 0.04 on team outcomes and of 0.05 on relational outcomes respectively. Joint development had a large effect size of 0.32 on team outcomes and a medium effect of 0.22 on relational outcomes; it had a small effect size of 0.05 on trust building. Trust building had a small effect of 0.09 on performance outcomes.

Knowledge-sharing had a large effect size of 0.35 on iterative requirements generation and had no effect on joint development. Iterative requirements generation had a large effect size of 0.37 on joint development and a medium effect size of 0.1 on cooperation structure. Coordination technology had a medium effect size of 0.17 on knowledge-sharing and a small effect size of 0.08 on iterative requirements generation. Communication Quality had a small effect size of 0.03 on iterative Requirements and of 0.04 on knowledge-sharing.

F-Square values	
Path	F2 values
Communication Quality -> Iterative Requirements Generation	0.03
Communication Quality -> Knowledge-sharing	0.04
Cooperation Structure -> Performance Outcomes	0.01
Cooperation Structure -> Relational Outcomes	0.05
Cooperation Structure -> Team Outcomes	0.04
Cooperation Structure -> Trust Building	0.67
Coordination Technology -> Iterative Requirements Generation	0.08
Coordination Technology -> Knowledge-sharing	0.17
Iterative Requirements Generation -> Cooperation Structure	0.1
Iterative Requirements Generation -> Joint Development	0.37
Joint Development -> Performance Outcomes	0.05
Joint Development -> Relational Outcomes	0.22
Joint Development -> Team Outcomes	0.32
Joint Development -> Trust Building	0.05
Knowledge-sharing -> Cooperation Structure	0.11
Knowledge-sharing -> Iterative Requirements Generation	0.35
Knowledge-sharing -> Joint Development	0
Trust Building -> Performance Outcomes	0.09
F2 values of 0.02, 0.15 and 0.35 are considered as small, medium, and large respectively	

Table 24: F-Square values

5.5.5 Total Effect

Total effect is the sum of direct and indirect effects. The interpretation of total effects is particularly useful in studies aimed at exploring the differential impacts of several driver constructs (Hair Jr et al. 2016).

Table 25 shows the total effects for all the paths in the research model. Among all the constructs, iterative requirements generation had the strongest total effect on performance outcomes (0.3), followed by coordination technology (0.22), and communication quality (0.06). Coordination Technology had strong effects on cooperative structure (0.34) and joint development (0.34) respectively. Therefore, it is wise for companies to focus on coordination technology and collaborative development process that positively influence the performance of the project and the outcomes related to the final product.

Total Effect			
Paths	Total Effect	T Statistics	P Values
Communication Quality -> Cooperative Structure	0.12	2.09	0.04
Communication Quality -> Joint Development	0.07	2.12	0.03
Communication Quality -> Performance Outcomes	0.06	2.08	0.04
Communication Quality -> Relational Outcomes	0.06	1.97	0.05
Communication Quality -> Team Outcomes	0.06	2.04	0.04
Communication Quality -> Trust Building	0.09	2.01	0.04
Coordination Technology -> Cooperative Structure	0.34	5.39	0
Coordination Technology -> Joint Development	0.36	6.24	0
Coordination Technology -> Performance Outcomes	0.22	5.22	0
Coordination Technology -> Relational Outcomes	0.23	5.3	0
Coordination Technology -> Team Outcomes	0.25	5.84	0
Coordination Technology -> Trust Building	0.28	5.16	0
Iterative Requirements Generation -> Performance Outcomes	0.3	5.68	0
Iterative Requirements Generation -> Relational Outcomes	0.36	7.34	0
Iterative Requirements Generation -> Team Outcomes	0.4	8.62	0
Iterative Requirements Generation -> Trust Building	0.33	4.73	0
Knowledge-sharing -> Performance Outcomes	0.28	6.37	0
Knowledge-sharing -> Relational Outcomes	0.26	5.46	0
Knowledge-sharing -> Team Outcomes	0.26	5.68	0
Knowledge-sharing -> Trust Building	0.39	7.88	0
P Values< 0.05 indicate a significant total effect			

Table 25: Total Effect

5.6 The Structural Model Assessment - Part 2

We accessed the contextual (collaborative culture and client's control) impacts on IT project collaboration using two separate models. The key criteria for assessing the structural model Part 2 are the same as those for the previous model (the significance of the path coefficients, the level of the R2 values, the F2 effect size, the predictive relevance, and the total effect size) (Hair Jr et al. 2016).

5.6.1 Internal consistency reliability

We followed Hair (2016)'s to guidelines and used Cronbach's Alpha and composite reliability to assess internal consistency reliability for the constructs in the new model. Internal consistency reliability values below 0.60 indicate a lack of internal consistency reliability; values above the recommended threshold of 0.70 can be regarded as satisfactory (Chin 1998b). As shown in Table 26. Each reflective construct in our research model demonstrated a level of reliability well above the recommended threshold of 0.70.

Internal consistency reliability (Model: Part 2)		
Constructs	Cronbach's Alpha	Composite Reliability
Collaborative Culture	0.9	0.93
Cooperation Structure	0.85	0.9
Joint Development	0.82	0.88
Behavioral Control	0.72	0.84
Outcome Control	0.9	0.93
Performance Outcome	0.86	0.92
The recommended threshold for both Cronbach's Alpha and Composite Reliability: > 0.70		

Table 26: Internal consistency reliability (Model: Part 2)

5.6.2 Convergent Validity

As demonstrated in Table 27, we established convergent validity for the reflective constructs by assessing the outer loadings of all indicators. The outer loadings of all indicators should be statistically significant (Hair Jr et al. 2016; Lowry and Gaskin 2014). All of our reflective indicators were significant at the 0.05 level on this test.

Outer loadings and Significant test (Model: Part 2)				
Constructs	Indicators	Loading	T Statistics	P Values
Cooperation Structure	CoopStr_1	0.84	29.97	0
	CoopStr_2	0.85	21.17	0
	CoopStr_3	0.85	21.9	0
	CoopStr_4	0.79	19.05	0
Collaborative Culture	Culture_1	0.87	37.91	0
	Culture_2	0.9	43.43	0
	Culture_3	0.89	26.43	0
	Culture_4	0.85	28.85	0
Joint Development	JointDev_1	0.76	20.83	0
	JointDev_2	0.84	20.01	0
	JointDev_3	0.89	30.17	0
	JointDev_4	0.72	13.13	0
Behavioral Control	BehCtrl_1	0.9	35.62	0
	BehCtrl_2	0.92	75.83	0
	BehCtrl_3	0.54	5.69	0
Outcome Control	OutCtrl_1	0.92	47.85	0
	OutCtrl_2	0.9	46.15	0

	OutCtrl_3	0.91	40.42	0
Performance Outcome	ProjOut_1	0.9	42.29	0
	ProjOut_2	0.88	32.36	0
	ProjOut_3	0.88	37.43	0
The recommended threshold for Loading: >0.708 The recommended threshold for P-value: <0.05				

Table 27: Outer loadings and significant test (Model: Part 2)

We then examined the values of the outer model loadings (commonly called indicator reliability). A common guideline is that the standardized outer loadings should be 0.708 or higher (Hair Jr et al. 2016). All of the outer loadings were significant at the 0.05 level with standardized outer loadings higher than 0.708 except for BehCtrl_3. BehCtrl_3 had a significant but fairly weak outer loading (0.54), which did not satisfy the 0.708 threshold. Thus, we excluded BehCtrl_3 in our further analysis to improve measurement reliability.

5.6.2.1 Average Variance Extracted (AVE)

As presented in Table 28, all constructs had AVE values of 0.50 or higher, indicating that the constructs explained more than half of the variances of its indicators (Hair Jr et al. 2016).

Average Variance Extracted (Model: Part 2)	
Constructs	Average Variance Extracted (AVE)
Collaborative Culture	0.77
Cooperation Structure	0.7
Joint Development	0.65
Behavioral Control	0.66
Outcome Control	0.83
Performance Outcome	0.79

The recommended threshold for AVE：>0.50

Table 28: Average Variance Extracted (Model: Part2)

5.6.3 Discriminant Validity

To determine the discriminant validity of our indicators, we used three established techniques (Cross Loading, Fornell-Larcker criterion and Heterotrait-monotrait ratio (HTMT)) (Hair Jr et al. 2016; Henseler et al. 2015; Lowry and Gaskin 2014).

Loading of the measurement Items (Model: Part 2)			
Client's Controls			
	Behavioral Control	Outcome Control	Performance Outcome
BehCtrl_1	0.9		
BehCtrl_2	0.92		
BehCtrl_3	0.54		
OutCtrl_1		0.92	
OutCtrl_2		0.9	
OutCtrl_3		0.91	
ProjOut_1			0.9
ProjOut_2			0.88
ProjOut_3			0.88
Collaborative Culture			
	Collaborative Culture	Cooperation Structure	Joint Development
CoopStr_1		0.84	
CoopStr_2		0.85	
CoopStr_3		0.85	
CoopStr_4		0.79	
Culture_1	0.87		
Culture_2	0.9		
Culture_3	0.89		
Culture_4	0.85		
JointDev_1			0.76
JointDev_2			0.84
JointDev_3			0.89
JointDev_4			0.72

Table 29: Loading of the measurement Items (Model: Part 2)

According to the cross-loadings results shown in Table 29, strong discriminant validity was established for all items except for BehCtrl_3 which was a measure of behavioral control. The loadings of the items in this table were greater for the latent variable to which they theoretically belonged than for any other latent variables.

5.6.4 Fornell-Larcker Criterion

To establish discriminant validity further, we calculated the average variance extracted (AVE) and ran a correlation of each variable with each other variable and then compared these correlations to the square root of the AVE for each construct (Fornell and Larcker 1981). As shown in Table 30, the Fornell-Larcker Criterion analysis showed a strong discriminant validity for all constructs, further confirming the choices of items.

Fornell-Larcker Criterion (Model: Part 2)			
Collaborative Culture			
	Collaborative Culture	Cooperation Structure	Joint Development
Collaborative Culture	(0.88)		
Cooperation Structure	0.58	(0.83)	
Joint Development	0.48	0.48	(0.8)
Client's Controls			
	Behavioral Control	Outcome Control	Performance Outcome
Behavioral Control	(0.81)		
Outcome Control	0.5	(0.91)	
Performance Outcome	0.56	0.49	(0.89)

Threshold: diagonal values should be greater than any other correlation

Table 30: Fornell-Larcker Criterion (Model: Part 2)

5.6.5 Heterotrait-monotrait ratio (HTMT)

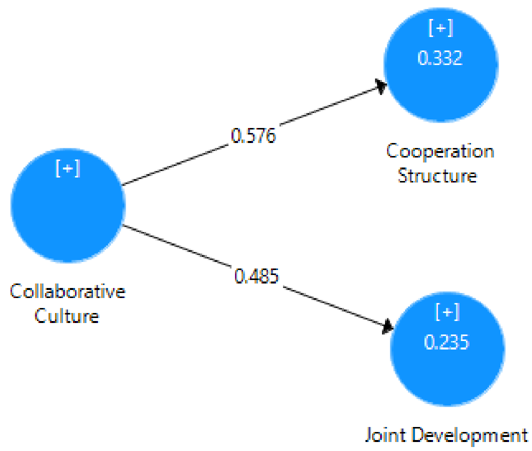
As shown in Table 31, the Heterotrait-monotrait ratio (HTMT) showed strong discriminant validity for all constructs.

Heterotrait-monotrait Ratio (Model: Part 2)			
Constructs	Collaborative Culture	Cooperation Structure	Joint Development
Collaborative Culture			
Cooperation Structure	0.65		
Joint Development	0.53	0.56	
Client's Controls			
Constructs	Behavioral Control	Outcome Control	Performance Outcome
Behavioral Control			
Outcome Control	0.6		
Performance Outcome	0.68	0.55	
Threshold:: < 0.85			

Table 31: Heterotrait-monotrait ratio (Model: Part 2)

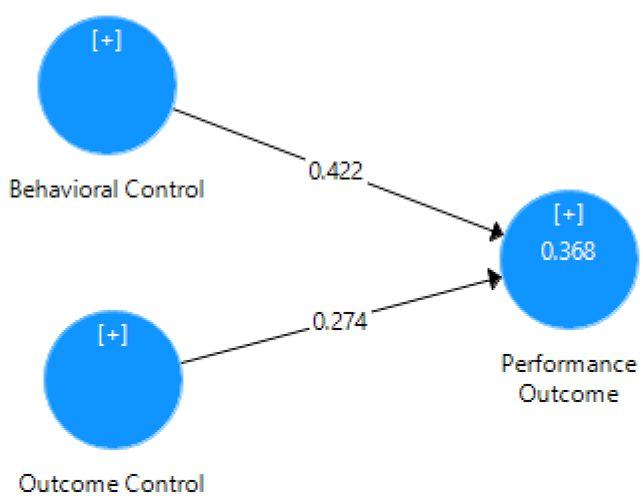
The effects of collaborative team vulture on the two components of collaboration, cooperation structure and joint development, are illustrated in Figure 3 below.

Figure 3: Structural Model 2 (Contextual Effects: Culture)



The effects of client's controls' (behavioral control and outcome control) on project performance outcome are illustrated in Figure 4.

Figure 4: Structural Model 2 (Contextual Effects: Client's Controls)



5.6.6 Structural Model Collinearity

Table 32 presents that analysis results on Structural Model Collinearity Statistic (VIF). All VIF values were clearly below the threshold of 5. Therefore, structural model collinearity was not likely to be a critical issue in the structural model, and we can continue our data analysis into the next steps.

Structural Model Collinearity Statistic (VIF) (Model: Part 2)			
Constructs	Cooperation Structure	Joint Development	Performance Outcome
Collaborative Culture	1	1	
Cooperation Structure			
Joint Development			
Behavioral Control			1.34
Outcome Control			1.34
Performance Outcome			
Threshold: < 5			

Table 32: Structural Model Collinearity Statistic (VIF) (Model: Part 2)

5.6.7 Structural Model Path Coefficients

Path Coefficients and Significance Test (Model: Part 2)			
Path	Path Coefficients	T Statistics	P Values
Collaborative Culture -> Cooperation Structure	0.58	9.24	0
Collaborative Culture -> Joint Development	0.48	7.85	0
Behavioral Control -> Performance Outcome	0.42	5.44	0
Outcome Control -> Performance Outcome	0.27	3.82	0
P Values<0.05 indicate significant path			

Table 33: Path Coefficients and Significance Test (Model: Part 2)

As shown in the Table 33, we found that collaborative culture was a very important predictor for cooperation structure and joint development, followed by behavioral control and outcome control, which were important predictors of project performance outcome.

Coefficient of Determination (R2 Value)

Table 34 shows the R-square and R-square adjusted values of the structural models. A significant standardized path should have a R2 value close to 0.20 (and ideally 0.30 or higher) to indicate that the model has meaningful predictive (Lowry and Gaskin 2014).

Coefficient of Determination (R2 Value) (Model: Part 2)		
Constructs	R Square	R Square Adjusted
Cooperation Structure	0.33	0.33
Joint Development	0.23	0.23
Performance Outcome	0.37	0.36
Threshold: close to 0.20		

Table 34: Coefficient of Determination (R2 Value) (Model: Part 2)

5.6.8 F2 Effect Size

Table 35 shows the F2 value of the model (Part 2). F2 values of 0.02, 0.15 and 0.35 are considered as small, medium, and large respectively; effect size values of less than 0.02 indicate that there is no effect (Cohen 1988).

F2 Effect Size (Model: Part 2)			
Constructs	Cooperation Structure	Joint Development	Performance Outcome
Collaborative Culture	0.5	0.31	
Cooperation Structure			
Joint Development			
Behavioral Control			0.21
Outcome Control			0.09
Performance Outcome			
F2 values of 0.02, 0.15 and 0.35 are considered as small, medium, and large.			

Table 35:F2 Effect Size (Model: Part 2)

CHAPTER 6

6. DISCUSSION

In this chapter, we first summarize the analyzed results of the study. Second, theoretical and practical contributions are discussed. Lastly, we discuss the limitations of the research and propose the directions for future research.

6.1 Summary of Results

One of the main objectives of this study was to test the relationships among the major variables related to IT project collaboration. This study identified the relationships between coordination variables (communication quality, coordination technology), IT development variables (iterative requirements generation, knowledge-sharing), collaboration variables (joint development, cooperation structure), and project outcomes (performance outcome, team (cultivation) outcomes, relational outcomes). This model explained 0.56% variance in iterative requirements generation, 34% in knowledge-sharing, 41% in cooperation structure, 43% in joint development, 34% in performance outcomes, 38% in team outcomes and 33% in relational outcomes. The survey data analysis showed support for 13 of the 16 hypotheses. Table 36 summarizes the hypothesis testing results.

No.	Hypothesis	Results
H1	The usage of coordination technology is positively associated with knowledge-sharing.	Supported
H2	The usage of coordination technology is positively associated with iterative requirement generation.	Supported

H3	The quality of communication is positively associated with knowledge-sharing.	Supported
H4	The quality of communication is positively associated with iterative requirement generation.	Not Supported
H5	Knowledge-sharing behaviors are positively associated with iterative requirement generation.	Supported
H6	Knowledge-sharing behaviors are positively associated with cooperation structure.	Supported
H7	Knowledge-sharing behaviors are positively associated with joint development behaviors.	Not supported
H8	The usage of iterative requirement generation process is positively related to cooperation structure.	Supported
H9	The usage of Iterative requirement generation process is positively related to joint development behaviors.	Supported
H10 a	Cooperation structure is positively related to project performance outcome.	Not Supported (Fully mediated by Trust)
H10 b	Trust mediates the effect of cooperation structure on project performance outcome	Supported
H11	Joint development is positively related to project performance outcome.	Supported
H12	Cooperation structure is positively related to team development outcome of the project.	Supported
H13	Joint development is positively related to team (cultivation) outcome of the project.	Supported
H14	Cooperation structure is positively related to relational outcome of the project.	Supported
H15	Joint development is positively related to relational outcome of the project.	Supported

Table 36: Hypothesis testing results

As hypothesized, both coordination variables (communication quality and coordination technology) affected IT development process variables (knowledge-sharing and iterative requirement generation). This implies that coordination factors can influence the effect and practice of IT development processes in IT project collaboration. Knowledge-sharing and iterative requirement generation were important enablers of collaborative behaviors (such as cooperation structure and joint development). Moreover, these collaborative behaviors could produce positive project outcomes, and these outcomes were not restricted to the project performance. Project team's growth, maturity and relational outcomes were also the key objectives of collaboration. Trust was an important mediator, which completely mediated the performance of the project through cooperation structure formation. It also served as a mediator to practically mediate performance of the project through joint development. Thus, we can conclude that collaborative behaviors can significantly influence trusts, and the mutual trust enables the two parties to success in achieving their common goals.

H1: The usage of coordination technology is positively associated with knowledge-sharing.

As can be seen from the analysis results, this hypothesis was supported as evidenced by the significant relationship between coordination technology and knowledge-sharing. (0.43, $p<0.05$). Prior knowledge of coordination suggests that coordination technology usage is one of the major efforts the project team makes to assist and deal with development related issues (Guinan et al. 1998). Coordination technology emerged in our study as an important variable with a positive relationship with knowledge-sharing. The emergence of coordination technology is in line with prior findings of the literature where coordination technology is shown to have both production (efficiency) effect and social (relationship) effects (Cooprider and Henderson 1990; Guinan et al. 1998; Stone et al. 1992; Williams et al. 2011). Coordination technology is significantly and positively related to knowledge-sharing between the two parties (client and vendor). This means that as the amount of coordination tools usage goes up, the effect and value of knowledge-sharing between the development team and the client goes up too. Thus, the coordination technology variable makes a very significant contribution towards the knowledge-sharing of the two parties.

H2: The usage of coordination technology is positively associated with iterative requirement generation.

The hypothesized relationship is significant (0.26; $p < 0.05$). The usage of coordination technology was positively related to the effect of iterative requirement generation. The finding is aligned with those of the prior literature. In addition to aiding internal team communication, modern coordination technology enables linkages with critical individuals outside of the team; such links are particularly important during knowledge-sharing and requirements generation (Cooprider and Henderson 1990; Guinan et al. 1998). Given that project teams may not be located onsite at the client locations; coordination technology provides a critical solution to some of the barriers created by remote collaboration. The project team can adopt many remote coordination tools to overcome the barriers encountered in remote collaboration.

H3: The quality of communication is positively associated with knowledge-sharing.

Communication quality had a significant effect on knowledge-sharing (0.21, 0.05). The quality of communication can significantly impact the effect of knowledge-sharing of the two parties (client and vendor). As discussed in Chapters Two and Three, prior studies suggested that the quality of communication is a critical factor that influences knowledge-sharing. To deal with design ambiguity, the project development team needs to constantly communicate with the client to exchange their understanding and coordinate project related problems. For example, even if the length of the communication may vary depending on the issues, the IT development team should exchange their ideas and understanding with its client as soon as they come across a problem. Honest and timely communication of the two parties helps them avoid and resolve potential misunderstandings. The development team should frequently communicate with its client and offer the client a continuous communication channel in the project development process.

H4: The quality of communication is positively associated with iterative requirement generation.

The hypothesized relationship was not significant (0.15, $p<0.1$). A possible explanation for the lack of findings here may have to do with the mediating effect of knowledge-sharing. Please see the Appendix for the analysis report. Knowledge-sharing fully mediated the effect of communication quality on iterative requirement generation process. Without the mediator (knowledge-sharing), the hypothesized relationship shown a significant coefficient (0.25, $P<0.05$). This result implies that, as a key coordination mechanism, communication plays a critical supporting role. However, without knowledge exchanging, the communication mechanism itself cannot produce the expected benefits.

H5: Knowledge-sharing behaviors are positively associated with iterative requirement generation.

The hypothesized relationship was strongly supported. (0.48, $p < .05$). Knowledge-sharing behaviors were positively associated with the effect of iterative requirement generation process. Knowledge-sharing behaviors offer great benefits to IT development creativities. The high path coefficient (0.48) supported this theoretical argument. Knowledge-sharing behaviors help increase the quantity and quality of ideas, increase the quality of problem-solving, and speed up the problem-solving process (Sheremata). IT requirement development is a creativity driven task, which strongly relies on existing knowledge and experience. Intensive knowledge-sharing behaviors benefit the client and the vendor by increasing the opportunities to discover and identify new IT and business requirements for their IT project through knowledge-sharing. Continuous requirement changes and developments require the support of the iterative requirement generation process. By focusing on the iterative customization and continuous modifications of work-in-progress IT systems, the iterative requirement generation process allows the vendor and the client team to incrementally and continually evolving the IT product designs.

H6: Knowledge-sharing behaviors are positively associated with cooperation structure.

Knowledge-sharing behaviors had a significant effect on the creation of cooperation structure (0.04, $p<0.05$). Knowledge-sharing behaviors were positively associated with cooperation structure building. Building a collaborative project structure is critical for project collaboration because of the intensity of the joint activities required for such projects. IT project cooperation structure represents the shared agreement between the two parties regarding the willingness to dedicate time, energy and recourses to achieve common objectives. Unlike simplistic project procedures or team agreements, if the shared agreements do not meet expectations, the client/vendor can move on to the next candidate or halt future collaboration opportunities. It is extremely interdependent and requires a considerable amount of time to build, adjust and refine during the project. Through frequent and effective knowledge-sharing and exchange, the two parties can learn from each other's knowledge, experiences, and objectives. Moreover, these knowledge, experiences and objectives help them to build, modify and refine their cooperation rules, procedures and common goals. In other words, these newly accumulated experience and knowledge help them advance their shared agreements and common rules during the project.

H7: Knowledge-sharing behaviors are positively associated with joint development behaviors.

Knowledge-sharing behaviors did not have a significant effect on joint development behaviors (0.04, $p<0.05$). Knowledge-sharing is not necessarily the cause of joint actions of the two parties. This finding implies that the exchange of knowledge and experience can indirectly influence the development of collaborative behaviors and activities. However, it cannot directly produce joint actions and teamwork without the support of other factors.

H8: The usage of iterative requirement generation process is positively related to cooperation structure.

The hypothesized relationship was significant (0.34, $p < .05$). The usage of Iterative requirement generation process was positively related to the development of cooperation structure. Iterative requirement generation process requires the development team to continuously cooperate with the client in the whole development cycle. Requirement design and development are highly uncertain and complex tasks, which focus on the feedback loops and anticipate future interaction. Most of the protocols and rules of these interactions are not clearly established in standard operating procedures and routines but rather often evolve to meet task demands (Ancona and Caldwell 1992). In other words, requirement design cooperation enables continuous interactions of the two parties (client and vendor), such interactions can help the two parties to produce and refine their cooperation structure, and the evolved cooperation structure will benefit their future interactions.

H9: The usage of Iterative requirement generation process is positively related to joint development behaviors.

The hypothesized relationship was supported (0.63, $p < .05$). The usage of Iterative requirement generation process was positively related to joint development behaviors. The core value of iterative requirement generation is to maximum the feasibility of product customization through the continual engagement and involvement of all the stakeholders and through the iterative feedback loops involving all the stakeholders. There are two major advantages of iterative requirement generation process. (1) The process can help the client accurately understand their development requirements. If the client thinks that there are requirements that need to be revised, they will work with the development team for the new requirements and modify or add the new requirements in the next iteration. Iterative product customization offers a better collaboration mechanism to the client. (2) Iterative requirement generation also helps the client evaluate and adjust their development plan in time. Iterative requirement planning is short-term based which allows the IT requirements to be constantly adjusted by the clients after each iteration. Thus, the iterative requirement generation process significantly empowers the direct interactions and joint actions of the two parties (client and vendor).

H10a: Cooperation structure is positively related to project performance outcome.

The hypothesized relationship was supported (0.35, $p<0.05$). Cooperation structure had a significant effect on the performance of the project. Mutual rules and agreements protect the performance of the IT project. Through project collaboration, IT development activities become more interconnected. Team members are required to concurrently work on the same tasks, both client and vendor are required to streamline their shared decision-making structure and to manage their cooperation activities concurrently. Thus, cooperation structure facilitates the protection role and help the project meet the development schedule, the development quality (such project scope, stability) and the budgets (Hoegl and Wagner 2005; Lee and Xia 2010). However, the hypothesized relationship was mediated by the mediator variable, trust. Trust as a mediator helped answer the question with regard to how the cooperation structure could have an effect on project performance.

H10b: Trust mediates the effect of cooperation structure on project performance outcome

When the mediator variable (trust) intervened between the two constructs (cooperation structure and performance outcome), their originally significant relationship became insignificant. The path coefficient of cooperative structure to performance outcomes became much smaller and insignificant after the mediator trust was added (0.12, $p<0.31$). Trust fully mediated the effect of cooperation structure on performance outcomes (indirect effect of 0.23, $p<0.05$). Trust is a set of beliefs or expectations which require the two parties to willingly act on those beliefs. Those beliefs may not be easily validated and may lack third parties' supervisions. Thus a protection structure is normally preferred for trust based joint actions. Cooperation structure can offer such protection. Cooperation structure is formed through soft and informal mutual rules, agreements and protocols. These structures are constantly evolving and improving while the two parties constantly participant in cooperative activities such as communication, knowledge-sharing, and iterative requirement generation. Such constantly evolving and improving protection mechanisms can directly generate trust. A previous study on trust building shows that if two parties need to obtain mutual benefits from each other, it is required that they trust each other and appear mutually trustworthy (Kedia and Lahiri 2007). It suggests that common rules and structures cannot directly benefit project performance without members' beliefs in such rules and agreements. Trust represents a mechanism that underlies the relationship between cooperation structure and performance outcomes. Cooperation structure leads to trust, and trust in turn leads to performance outcomes.

H11: Joint development is positively related to project performance outcome.

The hypothesized relationship was significant (0.35, $p < .05$). Joint development was positively related to the project performance outcome. Joint development behaviors have generally been found to have a positive relationship to product quality, adherence to product cost targets, adherence to development budgets, and adherence to development schedules. (Gulati et al. 2012; Hoegl and Wagner 2005). Our analysis results align with that previous theories. Joint development activities such as interpersonal problems solving, shared vision and joint pursuit of project objectives allow the client to participate in activities that traditionally are considered the vendor's responsibility. Conversely, such joint actions also encourage the vendor to proactively respond to the client's new requirements and continuous feedback cycles. Such boundaries spanning cooperative activities enable the client and the vendor to work together more interdependently to further achieve their project objectives.

H12: Cooperation structure is positively related to team development outcome of the project.

The hypothesized relationship was significant (0.19, $p < .05$). Cooperation structure building had a positive but moderate effect on team development outcome. Cooperation structure relates to the soft and informal mutual rules, agreements and protocols. These soft agreements and rules have not been formalized and are not the substitutes for the formal contract terms. However, giving enough time and sufficient diffusion, these agreements and rules have the potential to become best practices, formal contract terms and knowledge of the company. In other words, they have the potential to become the new institutions of the company.

H13: Joint development is positively related to team (cultivation) outcome of the project.

The hypothesized relationship was supported (0.5, $p < .05$). Joint development behaviors had a positive and large effect on team development. Joint development represents the interaction patterns between the two parties. The construct relates to the degree of interpenetration of organizational boundaries. In other words, the construct is measured by how significantly the work boundaries of the two parties have been penetrated by the integration of activities; to what degree the two parties need to carry out the major project activities in a cooperative or coordinated way. Moreover, if offering sufficient time and effort, these collaborative activates can further produce and reproduce new social practices, technologies, and rules through the continuous collaboration (Lawrence et al. 2002). In this study, we defined these new social practices, technologies, and rules as team (cultivation) outcome. The theoretical assumption w constructed through proto-institution theory and represent one of the major advantages of IT project collaboration. While IT project collaboration may not necessarily produce short-term economic benefits, it helps the project term accumulate experience, knowledge, and skills in an accelerated way. These newly accumulate experience, knowledge, and skills, if defused sufficiently, may become new institutional structures of the two parties.

H14: Cooperation structure is positively related to relational outcome of the project.

The hypothesized relationship was supported (0.22, $p<0.05$). Cooperation structure was positively related to the relational outcomes of the project. Cooperation structure is the protection mechanism of IT project collaboration. It is formed through soft and informal mutual rules, agreements and protocols, which represent the common objectives of the two parties. Thus, appropriate cooperation structures are desired for client-vendor relationship management and improvement. These structures benefit the two parties by offering an informal guideline for relationship managements. With the guiding and protecting roles of the structures, the two parties can be confident in collaboration. Such structures also provide the support for the development of future collaboration opportunities.

H15: Joint development is positively related to relational outcome of the project.

Joint development had significant effects on relational outcome (0.44, $p<0.05$). Joint development was positively related to the relational outcomes of the project. The finding aligns with those of the previous studies, which suggest collaboration can produce profound relational outcomes, such as partnership, extended service contract, and alliance (Jae-Nam and Young-Gul 1999; Jepperson 1991; Kedia and Lahiri 2007; Xia and Lee 2003). One of the main practices to produce a more profound client-vendor relationship is through constant project interactions and cooperation. Through the continuing project collaboration, client and vendors constantly form or shape their existing relationships or form new relationships.

Summary of Results Part II (The contextual influence)

Collaborative culture

Collaborative culture had significant effects on cooperation structure building (0.58, $p<0.05$) and joint development (0.48, $p<0.05$). Team culture is considered as an external influence which usually originated from the organization's culture climate. Previous studies suggest that project teams with a more collaborative culture are expected to advocate on collaborative behaviors (such as shared decision making, shared problem solving, mutual respect and mutual trust behaviors); members in such a culture climate expect to pursued morale and commitment (Cameron and Quinn 2005; Dey et al. 2010; Gopal et al. 2003). Thus, collaborative culture can engage the joint actions of the two parties and stimulate the formation of collaboration structures. Our statistical analysis supported these relationships.

Client's controls

Client's behavioral control had significant effects on project performance (0.42, $p<0.05$). Client's outcome controls had significant effects on project performance (0.27, $p<0.05$). Thus, the results suggest that client's overall controls were positively related to project performance. A previous study suggests that the traditional project development and management logics, such as project control, hierarchy or formal roles based team climate, and financial incentives are less powerful than those under a collaborative relationship (Lakhani et al. 2012). However, our analysis suggests that client's overall controls may be less influential under the collaborative relationship. It still has a critical impact on project performance. The critical role of control has been supported by the statistical analysis.

6.2 Conclusion

In this study, we tested four sets of hypotheses, the first related to coordination quality and its impact on IT development processes (such as knowledge-sharing process and iterative requirement generation process). While most of the hypotheses in this set were supported, one was not. Quality of communication did not have a significant effect on iterative requirement generation. We proposed a possible alternative explanation for this finding in terms of the mediating effect of knowledge-sharing. Knowledge-sharing fully mediated the effect of communication quality on iterative requirement generation process. This result implies that, as a key coordination mechanism, communication plays a critical role. However, without comprehensive objectives (such as knowledge-sharing), the communication mechanism itself cannot produce expected benefits.

The second set of hypotheses centered around the direct impacts of IT development processes on project collaboration. These hypotheses were supported. This provides evidence that IT development processes (Knowledge-sharing and iterative requirement generation process) have critical influences on IT project collaboration. We also found that knowledge exchanging activities significantly improved the level of usage of iterative requirement generation process.

The third set of hypotheses focused on the relationships among project performance, team (cultivation), and relational outcomes of IT project collaboration. These hypotheses were supported. There was a minor measurement validity issue however that was present in this set of hypothesis testing. While cross-loadings analysis and Fornell-Larcker Criterion test did not identify any discriminant validity issues, the most rigorous Heterotrait-monotrait ratio (HTMT) assessment suggested that team (cultivation) outcome construct was correlated with relational outcome. However, team outcomes were still close to the less conservative HTMT standard (0.9). Also, both the team (cultivation) outcome and relational outcome were parts of the emerging outcomes of project collaboration. Thus, they were theoretically related in nature. Moreover, even if two constructs were slightly, but not completely, correlated with values close to 1.0, the criterion is still unlikely to indicate a lack of discriminant validity, particularly when (1) the loadings are homogeneous and high or (2) the sample size is large (Henseler et al. 2015). Considering the loading of the two constructs were homogeneous and high, we considered this to be sufficiently valid.

One of the most interesting findings was that trust fully mediated the effect of cooperation structure on performance outcomes. It suggests that common rules and structures cannot directly benefit project performance without members' beliefs in those rules and agreements. Trust represents a mechanism that underlies the relationship between cooperation structure and performance outcomes. Cooperation structure leads to trust, and trust in turn leads to performance outcomes.

The final set of hypotheses were regarding the context's (client's control and collaborative culture) influences on project collaboration and performance. The overall models were significant, suggesting that collaborative culture can facilitate the joint actions of the two parties and stimulate the formation of collaboration behaviors. Though client's overall controls may be less influential in the collaborative relationship, they still play critical roles in influencing project performance.

6.3 Theoretical Contributions

This study makes a few critical contributions to our understanding of factors related to IT project collaboration.

First, the operationalization of IT development collaboration as two consisting of two components makes a novel contribution. This study contributes to IS literature by constructing new empirical measures for IT project collaboration. Such empirical measures provide scholars with a foundation when they build up their future research based on the construct of IT development collaboration. Given that there are no existing studies on IT project collaboration measurement, this study provides a first effort to start the first critical stage of operationalizing the construct of IT development collaboration in a manner that was consistent with that existing theoretical understanding, and at the same time measurable and verifiable in quantitative analysis. This construct conceptualization and measurement stage is critical for our research development. Our survey instrument development goes through multiple iterations, and the final measurement demonstrated adequate reliability and validity. The operationalized constructs of IT development collaboration involve the assessment of both the mutual structural agreements and joint action behaviors of the two parties. We proposed the operationalization of IT development collaboration as two separate sub-constructs: joint development, and cooperation structure. These two co-exist in any IT collaboration behaviors. Joint development focusses on interpersonal problems solving, shared vision and joint pursuit of project objectives. Joint development allows client and vendor to work together to develop and test new product designs and technology solutions. Cooperation structure provides the initial and continuous clarity and protection on each party's commitments, roles, responsibilities, expectations, and resource needs.

Second, this study contributes to the literature by examining the impacts of IT development processes on the creation of IT collaboration. This study has provided strong evidence for the interactive role of IT development processes play in influencing the creation of IT project collaboration. Various IT development processes have been adopted by IT vendors as the mediums to produce and engage collaborative development activities (Hoda et al. 2011). These IT practices have been promoted and used as techniques to enable IT project collaboration.

We examined major IT design and development activities performed for the purpose of IT development interaction. We also identified key coordination practices (such as communication and coordination technology), which enhance or support those interactive development processes. These coordination practices facilitate the frequent information sharing and feedback gathering of the two parties. For instance, we know that interactive development can create collaboration but what would lead to intensive usage of interactive development processes has not been fully studied. By defining the constructs of communication quality and coordination technology, we contribute to the literature by demonstrating the enabling role of coordination practices on IT development processes.

Third, this study contributes to the literature by identifying and verifying the emerging outcomes of IT project collaboration. This study makes a critical contribution to our understanding about the emerging outcomes of IT project collaboration. The unit of analysis of our study is project, which provides an important context in which an important research aspect has been overlooked by the literature — the emerging development of the project team. We define such developments as the emerging outcomes. The emerging outcomes (such as improved practices, new technologies, enhanced rules and client relationship) are mutual benefits based, including the aspects of team (cultivation) outcome and relational outcome. These outcomes are not economic driven. They are produced through the activities of project collaboration by the development and the vendor through the project. Such outcomes may not have yet to be diffused organizationally but may have the potential to become widely institutionalized (Lawrence et al. 2002). In other words, while these new practices, technology rules and relationship binding are not diffused to a great scale, they have the potential to be fully institutionalized in the further if the organizations are given enough time and support.

Fourth, this study contributes to the literature by examining the influences of project contextual variables on the development of IT project collaboration and its outcomes. IT project collaboration studies have primarily been focused on the core and root reasons of project collaboration, such as the effective knowledge-sharing and efficient product design and modification processes. Although previous studies suggested that project contexts have a significant impact on IT development, few studies have examined the influences of project contexts on IT project collaboration. Our study suggests that project teams with a more collaborative culture demonstrated more collaborative behaviors. This study also suggests that the client's overall control may be less influential under a collaborative association. However, they still play critical roles in influencing project performance.

Our findings about coordination technology offer a critical insight to project managers who are struggling with issues of knowledge-sharing and transferring. Coordination tools are essential coordination media for knowledge-sharing and information exchange. Thus, the adoption and use of coordination technologies would create a much need common context for inter-team and intra-team knowledge-sharing.

6.4 Practical Implications

This research has several practical implications. First, our in-depth and empirical interpretations of IT project collaboration allow project stakeholders to comprehend how to create and encourage collaborative activities. It is important to recognize that collaborative tasks are complex, time consuming, human capital intensive, and interdependent. Our empirical analysis of IT project collaboration helps bring the key values and facts of project collaboration to the project stakeholders. Without such in-depth and empirical analysis, even a highly experienced project manager or team leader may not be able to realize its potential value.

Second, our analysis of the interactive roles of IT development processes helps project stakeholders consider how to enable and utilize knowledge-sharing processes; and how to develop product requirements by using such interaction channels effectively. Interactive design processes also help project stakeholders assess the practical values of earlier product designs by iteratively develop and evaluate their product requirements.

Third, study's analysis of collaborative team culture's role in the creation of IT project collaboration provides additional insights to the practitioners. The results suggest that collaborative team culture plays a significant role in influencing the establishment of IT project collaboration. Project managers can adapt the instrument to evaluate their team's culture climate and accordingly make necessary organizational adjustments. Team members may also use this survey instrument to do self-assessments to understand their professional development and project performance status.

6.5 Limitations and Future Research

This study has several limitations that should be taken into consideration while interpreting the findings.

First, in this study, we did not explicitly consider the characteristics of contract terms which may have a significant effect on the levels of project collaboration. Future studies may take into account of the effect of contract characteristics on the client-vendor collaboration. This research collected descriptive statistic of project contract types. However, PLS do not allow the analysis of categorical variables for statistical analysis. Alternatively, the categorical variable may be transformed into dummy variables for the purpose of statistical analysis. Considering it is not the focus of this study and adding a new dummy variables will significantly increase the complexity of the current research model, we did not explicitly consider contract characteristics in our study.

Second, in this study, the measurement perspective was mainly from the IT vendors' perspectives. The survey data were collected from IT vendor companies. One of the major weaknesses of taking only the vendor's perspective is that some project outcome measurements (such as relationship outcomes and some performance outcomes) were about the vendor's perceived values. We did not access the constructs from the perspective of the client, which is as a result of the lack of contact with the clients.

Third, some of the relevant variables suggested by previous studies did not fit well with our micro level research model and were not included in our study. For example, team culture can impact the collaboration patterns significantly. However, it is hard to interpret how team culture as an antecedent can impact the selection/usage of IT development processes. Team culture, as an abstract contextual factor, is difficult to analyze and interpret in a micro level research (especially in complex research designs) which is designed to examine specific issues in a concrete way. There is a general lack of literature guides on how to link macro level constructs to micro level research design. For example, team's collaborative culture may play a role in iterative requirement generation. However, by doing that, the collaborative cultural ideology has to penetrate to the majority of the team's work activities. Thus, cultural measurements require assessing various activities in different administrative and task settings. By doing that, the cultural influence cannot be defined by a clear classification and will be correlated with many organizational and behavioral features. Such correlations can produce significant issues in micro-level research. In micro level statistical research, investigated variables need to produce a relatively single directional relationship. Moreover, its direct effect on endogenous construct must be defined and interpreted clearly. The measurement of a construct should be narrowly defined in a way that can be identified and categorized. However, such measurements are difficult to construct in culture-related research. Team culture as a construct, in our research setting, can have direct effects on many exogenous constructs or can have indirects effect on many endogenous constructs. However, the mechanisms of such impacts are unclear. We are not certain what mechanisms of culture may directly influence the outcome of collaboration. We can only hypothesize that culture may change the level of collaboration in general, but it is difficult to interpret the mechanisms underlining such changes. Otherwise, we can infer that culture is not a direct concrete effort to any causations. Thus, our direct interpretation of culture impact may look superficial. Abstracts (Macro level) constructs should only be linked to the same level constructs. We should not interpret an abstract construct's specific behavioral patterns, considering there may be countless patterns inside an abstract construct, and they all function in different ways.

Also, similar issues are applicable to the construct of the client's controls. Previous studies suggested that client's controls can significantly impact IT project performance. However, the macro level contract is abstract in nature and it is hard to match with other micro level measurements. In this study, we have developed separated research models to test the effects of these contextual variables suggested by previous studies. Thus, future studies should identify new team level culture variables which can be incorproated into project or team level analysis. It is also important to investigate how team culture variables can facilitate or inhibit the adoption and utilization of IT development processes.

Fourth, the research participants are IT professionals, and project stakeholders involved IT project collaboration. However, the findings may not apply to other subpopulations in dissimilar project settings. We enhance the generalizability of our studies by applying theories that are not limited to the IT/IS fielding, including marketing, management and operational management theories.

Fifth, this study demonstrates that IT project collaboration can produce many emerging and non-economic outcomes, such as team development and growth. Future studies should pay more attentions to these emerging and non-economic benefits. Such emerging outcomes may not be able to demonstrate benefits in a short period of time. However, this represents that latest efforts for team cultivation among the contemporary organizations. Giving enough time and effort, it can become the core compatibility of the IT vendors.

Lastly, future studies may study internal (within team) collaboration and develop insights about its relationships with team cultivation and growth. Literature and our field research suggest that there is a tradeoff between internal (within team) collaboration and project controls (such as schedule management, task management, and performance management). While empirical knowledge and experience suggest that such tradeoffs exist, companies still attempt to build environments to engage internal collaborations. The critical determinations for such decisions are topics that are worthy for further investigations.

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APPENDICES

APPENDIX1: Raw Path Coefficients Tables

Raw Path Coefficients Table (without Mediating Effects)					
Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
Communication Quality -> Iterative Requirements Generation	0.15	0.15	0.09	1.62	0.11
Communication Quality -> Knowledge-sharing	0.21	0.21	0.1	2.2	0.03
Cooperative Structure -> Performance Outcomes	0.35	0.36	0.07	4.73	0
Cooperative Structure -> Relational Outcomes	0.22	0.22	0.09	2.53	0.01
Cooperative Structure -> Team Outcomes	0.19	0.19	0.08	2.27	0.02
Coordination Technology -> Iterative Requirements Generation	0.26	0.26	0.09	2.87	0
Coordination Technology -> Knowledge-sharing	0.43	0.43	0.08	5.24	0
Iterative Requirements Generation -> Cooperative Structure	0.34	0.33	0.1	3.54	0
Iterative Requirements Generation -> Joint Development	0.64	0.63	0.08	8.18	0
Joint Development-> Performance Outcomes	0.27	0.28	0.06	4.82	0
Joint Development-> Relational Outcomes	0.43	0.44	0.07	6.09	0
Joint Development-> Team Outcomes	0.5	0.51	0.08	6.13	0
Knowledge-sharing-> Cooperative Structure	0.36	0.36	0.09	4.07	0
Knowledge-sharing-> Iterative Requirements Generation	0.48	0.47	0.08	6.29	0

Knowledge-sharing -> Joint Development	0.03	0.03	0.1	0.28	0.78

Table 37: Raw Path Coefficients Table

Raw Path Coefficients Table (without Mediating Effects)

Raw Path Coefficients Table (without Mediating Effects)					
Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
Communication Quality -> Knowledge-sharing	0.22	0.22	0.09	2.33	0.02
Cooperative Structure -> Performance Outcomes	0.12	0.11	0.12	1.01	0.31
Cooperative Structure -> Relational Outcomes	0.22	0.22	0.09	2.47	0.01
Cooperative Structure -> Team Outcomes	0.17	0.18	0.1	1.78	0.08
Cooperative Structure -> Trust Building	0.63	0.64	0.07	8.49	0
Coordination Technology -> Iterative Requirements Generation	0.34	0.34	0.07	4.59	0
Coordination Technology -> Knowledge-sharing	0.42	0.43	0.08	5.23	0
Iterative Requirements Generation -> Cooperative Structure	0.33	0.33	0.1	3.46	0
Iterative Requirements	0.66	0.66	0.05	12.18	0

Generation -> Joint Development					
Joint Development -> Performance Outcomes	0.21	0.21	0.06	3.55	0
Joint Development -> Relational Outcomes	0.44	0.44	0.07	6.19	0
Joint Development -> Team Outcomes	0.51	0.52	0.09	5.96	0
Joint Development -> Trust Building	0.17	0.17	0.07	2.44	0.01
Knowledge-sharing -> Cooperative Structure	0.36	0.37	0.09	4.13	0
Knowledge-sharing -> Iterative Requirements Generation	0.5	0.5	0.07	6.8	0
Trust Building -> Performance Outcomes	0.36	0.38	0.11	3.31	0

Table 38: Raw Path Coefficients Table (with Mediating Effects)

APPENDIX 2: Indirect Effects and their significance Table

Indirect Effects and their significance					
Indirect Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
Communication Quality -> Cooperative Structure	0.16	0.16	0.06	2.48	0.01
Communication Quality -> Iterative Requirements Generation	0.1	0.1	0.05	2.16	0.03
Communication Quality -> Joint Development	0.16	0.17	0.07	2.52	0.01
Communication Quality -> Knowledge-sharing					

Communication Quality -> Performance Outcomes	0.09	0.1	0.04	2.58	0.01
Communication Quality -> Relational Outcomes	0.11	0.11	0.04	2.46	0.01
Communication Quality -> Team Outcomes	0.11	0.11	0.04	2.55	0.01
Communication Quality -> Trust	0.11	0.12	0.05	2.29	0.02
Cooperative Structure -> Performance Outcomes	0.26	0.27	0.09	2.9	0
Coordination Technology -> Cooperative Structure	0.31	0.31	0.06	5.12	0
Coordination Technology -> Iterative Requirements Generation	0.2	0.21	0.05	3.79	0
Coordination Technology -> Joint Development	0.31	0.31	0.07	4.53	0
Coordination Technology -> Performance Outcomes	0.18	0.19	0.04	4.44	0
Coordination Technology -> Relational Outcomes	0.2	0.21	0.04	4.51	0
Coordination Technology -> Team Outcomes	0.21	0.22	0.05	4.63	0
Coordination Technology -> Trust	0.22	0.23	0.05	4.59	0
Iterative Requirements Generation ->	0.26	0.26	0.05	5.12	0

Performance Outcomes					
Iterative Requirements Generation -> Relational Outcomes	0.35	0.35	0.05	7.32	0
Iterative Requirements Generation -> Team Outcomes	0.39	0.39	0.05	7.91	0
Iterative Requirements Generation -> Trust	0.24	0.24	0.08	3.17	0
Knowledge-sharing -> Cooperative Structure	0.16	0.16	0.05	3.02	0
Knowledge-sharing -> Joint Development	0.3	0.3	0.05	5.68	0
Knowledge-sharing -> Performance Outcomes	0.27	0.27	0.05	5.75	0
Knowledge-sharing -> Relational Outcomes	0.26	0.26	0.06	4.54	0
Knowledge-sharing -> Team Outcomes	0.26	0.27	0.06	4.4	0
Knowledge-sharing -> Trust	0.37	0.38	0.05	7.33	0

Table 39: Indirect Effects and Their Significance

APPENDIX 3: Trust's Moderation Effect Test

Moderation is similar to mediation in that a third variable (i.e., a mediator or moderator variable) affects the strength of a relationship between two latent variables (Hair Jr et al. 2016). However, the key difference between the two concepts is that the moderator variable does not depend on the exogenous construct; In contrast, with mediation there is a direct effect between the exogenous construct and the mediator variable (Hair Jr et al. 2016). Moderator relationships are tested statistically by checking for interaction effects among independent variables using the product indicator (PI) approach proposed by Chin et al. (Chin et al. 2003). The product indicator approach is the standard and the most effective approach for identifying interaction in complex path models (Chin et al. 2003; Hair Jr et al. 2016; Lowry and Gaskin 2014).

Our theory proposed that the relationship between cooperation structure and project performance was moderated by trust. The higher the trust between the two parties, the more the project performance would be affected by cooperation structure. Thus, we hypothesized that the relationship between cooperation structure and project performance was influenced by the level of trust between the two parties.

The result suggested that the interaction of cooperative structure and erformance outcomes was not significant. Consequently, in the interaction model, the two small path coefficients between moderators and performance outcomes were not significant. Our results showed a small interaction and insignificant interaction effect.

Moderating Effect	Path Coefficient	Sample Mean	Standard Deviation	T Statistics	P Values
Moderating Effect Cooperative	0.04	0.05	0.08	0.56	0.57

Structure -> Performance Outcomes					
Moderating Effect Joint Development -> Performance Outcomes	-0.02	-0.03	0.09	0.2	0.202

Table 40: Moderating Effect

Figure 5: Moderating Effect Path Coefficients

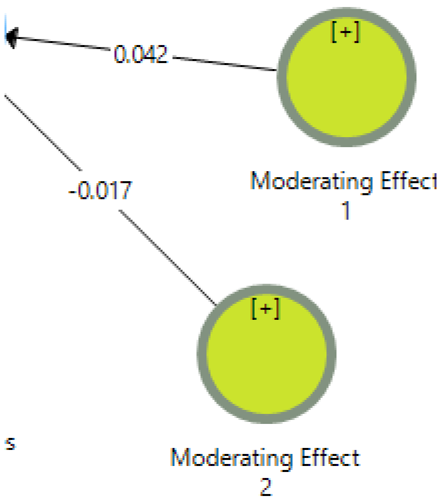
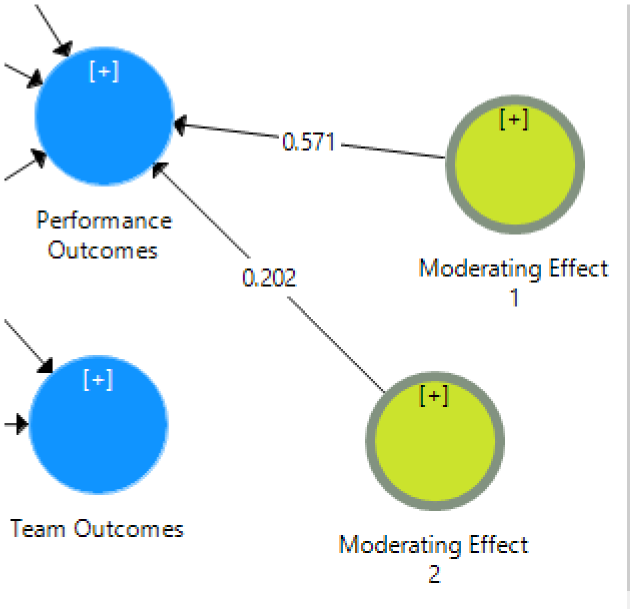


Figure 6:: Moderating Effect T-Statistics



APPENDIX 4: Trust's Mediation Effect on Performance Outcome through Joint Development

First, we accessed the significance of the indirect effect.

THE SIGNIFICANCE OF THE INDIRECT EFFECT				
Indirect Paths	Indirect Effect	95% Confidence Intervals of Indirect Effect	T Statistics	P Values
Joint Development -> Performance Outcomes	0.06	{0.02, 0.13}	2.19	0.03
P Value < 0.05 indicate a significant indirect path				

Table 41: Trust's Mediation Effect through Joint Development

We found that both indirect effects were significant since neither of the 95% confidence intervals contained zero (Hair Jr et al. 2016). We also reported the t-value and p value for significance testing. For the indirect effect of the joint development -> performance outcomes relationship, we obtained (0.06) a t-value of 2.19 with a p-value of 0.03.

THE SIGNIFICANCE OF THE DIRECT EFFECT				
	Direct Effect	95% Confidence Intervals of Direct Effect	T Statistics	P Values
Joint Development -> Performance Outcomes	0.21	{0.09, 0.32}	3.59	0
P Value < 0.05 indicate a significant indirect path				

Table 42: The Significance of The Indirect Effect

We continued the mediation analysis procedure. The next step focused on the significance of the direct effects from joint development -> performance outcomes. Joint Development exerted a pronounced (0.21) and significant ($t = 3.59$; $p < 0.001$) effect on performance outcomes. We therefore concluded that trust partially mediated the relationship since both the direct and the indirect effects were significant.

Path Coefficients and Significance Test (main model: mediation model comparison)						
Path	Without mediation			With mediation		
	Path Coefficients	T Statistics	P Values	Path Coefficients	T Statistics	P Values
Joint Development -> Performance Outcomes	0.27	4.91	0	0.21	3.62	0
P Values<0.05 means the path is Significance						

Table 43: Path Coefficients and Significance Test (comparison)

Zhao (2010) identified two types of partial mediation: complementary mediation and competitive mediation (Zhao et al. 2010). Complementary mediation occurs when the indirect effect and the direct effect both are significant and point in the same direction. Competitive mediation occurs when the indirect effect and the direct effect both are significant and point in opposite directions. Indirect-only mediation refers to situation where the indirect effect is significant but not the direct effect.

Thus, to further substantiate the type of partial mediation for joint development -> performance outcomes relationship, we next computed the product between the direct effect and the indirect effect. Since the direct and the indirect effects were both positive, the sign of their product was also positive ($0.06 \cdot 0.21 = 0.012$), we concluded that trust represented a complementary mediation on the relationship from development to performance outcomes relationship.

Joint development has been recognized as increasingly importance for trust building. For the relationship between joint development and performance outcomes, trust serves as a complementary mediator. Higher levels of joint development activities increase positive performance outcomes directly but also increase trust, which in turn leads to positive performance outcomes. Hence, some of joint development’s effect on performance outcomes can be explained by trust.

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Zhang,M., Xia,W,(Work-in-progress*). Client-Vendor Collaboration on IT Development Projects*. Targeted for MIS Quarterly.

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