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How to Generate More Value from IT: The Interplay of IT Investment, Decision Making Structure, and Senior Management Involvement in IT Governance

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Abstract:

Information technology (IT) represents a large portion of an organization's investments. Prior research has identified the linkage between IT investment and productivity. Numerous factors affect the value an organization can derive from its IT investment. However, extant literature has insufficiently studied IT governance's impact on IT's business value. In this study, we help to fill this gap by investigating the effects of IT decision making structure mechanisms and senior management's IT governance involvement on the relationship between IT investment and organizational performance. This study builds on a novel framework that integrates two theories on IT in an organizational setting: strategic choice theory and contingency theory. We pool organization-level IT investment and IT governance practice data with other organization characteristics to investigate the moderating effects of IT governance practices. The empirical analyses reveal a positive moderating effect of IT decision making structure mechanisms on the IT investment–organization performance relationship. Nevertheless, the results indicate that senior management's IT involvement has no significant effect on this relationship. This study shows the importance of IT governance for organizations to effectively leverage their IT investment.

Keywords: IT Investment, Organizational Performance, Business Value of IT, IT Governance, Strategic Choice, Contingency Theory.

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1 Introduction

Both the information systems (IS) (Bharadwaj, Bharadwaj, & Konsynski, 1999; Hitt & Brynjolfsson, 1996; Lee, 2008; Lee & Kim, 2006; Yao, Liu, & Chan, 2010) and strategic management literatures (Ho, Wu, & Xu, 2011; Porter, 2001; Teece, 2007) have widely discussed the relationship between information technology (IT) investment and overall organizational performance at multiple levels of analysis in the past three decades. Researchers have long debated the business value of IT investment. Although researchers once believed information technology to improve productivity, studies conducted in the 1980s found no significant relationship between IT investment and organizations' productivity (Solow, 1987). Since then, this "productivity paradox" has drawn researchers to investigate IT investment's impact on organizational productivity and, more broadly, IT's business value (Anderson, Banker, & Ravindran, 2003; Brynjolfsson & Hitt, 1998; Shao, Feng, Choudrie, & Liu, 2010).

Brynjolfsson (1993) stated that shortcomings in research can explain the productivity paradox (mismeasurement of variables and ignored lags due to learning and adjustment) and practice (redistribution of profits and mismanagement of IT). Furthermore, theoretical issues, such as lack of considering contextual variables that might act as the moderator or mediator between IT investment and organizational productivity, also provides an explanation for the productivity paradox (Bulchand-Gidumal & Melián-González, 2011). With better measurements and more refined research methodologies, studies in the 1990s revealed a positive and significant relationship between IT investment and organizational productivity (Yao et al., 2010). Studies in the 2000s began to investigate the mechanisms through which IT generates value. Meanwhile, Carr (2003) proposed an opposing view: he argued that IT had become a commodity input rather than a strategic resource just like how steam engines or telephones evolved as their availability increased and their cost decreased. He suggested that the competitive advantage that IT provided at the beginning (when it was expensive and scarce) had vanished because of its availability to everybody. Proponents of this view claimed that IT investment had no strategic value to organizations because their competitors could duplicate the new IT applications (Beccalli, 2007; Lee, Song, Baker, Kim, & Wetherbe, 2011; Tangpong, 2008). However, Schrage (2003) quickly refuted the argument of resource scarcity being key to strategy. The value of standardized IT applications could differ between organizations because of their differences in processes, resources, managerial skills, and operational skills (Anderson, Banker, & Ravindran, 2006; Banker, Bardhan, Chang, & Lin, 2006; Barua et al., 2010). Despite progress made over the years to understand the business value of IT, researchers have yet to fully explain the fundamental question of the relationship between IT investment and organizational performance (Schryen, 2013).

While most recent studies show that IT investment positively affects organizational performance when an organization embeds it into its business processes (Bardhan, Krishnan, & Lin, 2013; Buchwald, Urbach, & Ahlemann, 2014), executives continue to question the business value of IT. Hence, demonstrating the business value of IT is fundamental to the IS field and important to practice (Agarwal & Lucas, 2005). As prior research suggests, the effect of IT investment on organizational performance depends on moderating factors such as IT management and processes (Osei-Bryson & Ko, 2004). As such, inquiries into whether IT investment increases organizational performance have now shifted to how, when, and why IT investment creates business value. Thus, we investigate such two moderating factors—decision making structure of IT governance and senior management involvement in IT governance—to determine their impact on the relationship between IT investment and organizational productivity. We break down IT investment measure as IT infrastructure and IT labor because the prior literature suggests that a single measure for IT investment does not account for IT investment's multiple components (Weill, 1992) (see Section 2.1 for details). Specifically, we address two important gaps that remain unanswered.

The first gap concerns IT governance mechanisms such as decision making structures, alignment processes, and communication approaches. Actual use of IT governance mechanisms varies across organizations. Eighty percent of chief information officers (CIOs) are not satisfied with the effectiveness of their IT governance (Ali & Green, 2012). Although more-effective IT governance mechanisms have led to better organizational performance in general (Weill & Ross, 2004), different IT governance mechanisms tend to have different effects on overall organizational performance (Ali & Green, 2012). Therefore, IT governance mechanisms play a significant role in the relationship between IT investment and organizational performance. However, little empirical work has examined the effect of IT governance mechanisms on this relationship. We directly address this research gap by developing a contingency theory-based perspective and empirically testing the moderating effects of decision making structure mechanisms on the relationship between IT investment and organizational productivity. The second gap

concerns the impact of senior management's involvement in IT governance. Despite the potential benefits of involving senior managers in IT governance, little empirical work has measured its impact on organizational performance. Drawing from strategic choice theory (Child, 1972), we propose a theoretical framework and develop hypotheses to better understand the effects of senior management involvement on the relationship between IT investment and organizational productivity.

The theoretical model we propose has two premises. First, an in-depth literature review indicates that IT governance research has mainly focused on the agency problem and notably missed the other key aspect: IT governance mechanisms. Drawing on contingency theory, we argue that IT governance mechanisms are internal factors that moderate the relationship between IT investment and organization performance. Second, following strategic choice theory, we suggest that senior management involvement in IT governance is another internal factor that affects the relationship between IT investment and organizational performance. We use organizational-level data from 230 organizations to examine these two gaps. This unique dataset captures IT investments of organizations, decision making structure mechanisms, and senior management involvement in IT governance. To measure organizational productivity, we calculate value added using data pooled from COMPUSTAT. We use market capital and industry based on two-digit North American Industry Classification System (NAICS) codes as control variables.

This study contributes to both theory and practice of deriving value from IT investment. The study focuses on analyzing the interplay between IT investment, IT governance practice, and organizational productivity. First, it provides an alternative approach to examining IT investment's impact on organization productivity by separating IT investment into two facets (i.e., IT infrastructure investments and IT labor investments). Additionally, it offers a new insight into why previous studies report contradicting results on the business value of IT by exploring the influence of IT governance. To our knowledge, this study represents the first to empirically test what impact decision making structure mechanisms and senior management involvement in IT governance have on the relationship between IT investment and organizational productivity. Our findings indicate that decision making structure mechanisms positively moderate the relationship between both facets of IT investment and organizational productivity. In other words, effective decision making structure mechanisms help organizations to realize more benefits from their IT infrastructure and IT labor investments. On the other hand, senior management involvement has no significant effect on business value of IT. While strategic choice theory suggests that managerial choices can positively affect organizational success, our results show that the level of senior management involvement in IT governance has no impact on the relationship between IT investment and organizational productivity. Finally, for this study, we used a primary source organizational-level dataset, which offers a more reliable measurement of IT investments. The second author (along with other researchers) collected the data from more than 300 organizations in 2005 through phone interviews. While prior studies have used datasets from the pre-Internet era (Brynjolfsson & Hitt, 1995) and during the dot-com boom era (Kudyba & Diwan, 2002), our dataset comes from a period after the Internet bubble and the first economic recession of this century. We assess the role of IT governance on the relationship between IT investment and organizational productivity using data on actual IT expenditures and financial performance indicators. As for key managerial implications, our findings suggest that senior managers do not need to become directly involved in IT governance. Instead, they should focus on creating the necessary conditions for developing effective decision making structure mechanisms; these mechanisms play a foundational role in leveraging IT investment to improve organizational productivity.

This paper proceeds as follows. In Section 2, we review the literature on the impact of IT investment on organizational performance. In Section 3, we describe the data-collection procedure, measurements, and statistical-analysis method we used to test hypotheses. In Section 4, we provide results of the analysis. In Section 5, we summarize the results and identify theoretical contributions, practical implications, limitations and future research opportunities. Finally, in Section 6, we conclude the paper.

2 Literature Review and Theory

2.1 IT Investment and Organizational Performance

In reviewing the literature on business value of IT, we found that studies have taken various approaches to investigate the relationship between organizational performance and IT investment. They have defined organizational performance as a broad concept that includes three facets: 1) profitability (Hitt & Brynjolfsson, 1996; Mithas, Tafti, Bardhan, & Goh, 2012), 2) productivity (Brynjolfsson, 1993; Brynjolfsson

& Hitt, 1998), and 3) market value (Dos Santos, Peffers, & Mauer, 1993; Kohli, Devaraj, & Ow, 2012). They have defined IT investment as any type of IT related expenditures, which includes hardware, software, training, labor cost, and cost of maintenance. Studies have used one or more of these facets to explore how IT investment affects organizational performance.

Studies have frequently measured organizational profitability in the form of profit ratios such as return on investment (Chakravarty, Grewal, & Sambamurthy, 2013; Chan, Sabherwal, & Thatcher, 2006), return on equity (Dehning & Richardson, 2002; Hitt & Brynjolfsson, 1996), return on sales (Chae, Koh, & Prybutok, 2014; Geletkanycz & Boyd, 2011), and return on assets (Chae et al., 2014; Geletkanycz & Boyd, 2011). Further, some studies have used cost ratios (Bharadwaj, 2000) and turnover ratios (Dehning & Richardson, 2002) to measure the profitability of organizations. Studies have also frequently used organizational productivity as an organizational performance measurement and generally measured it as value added (Brynjolfsson & Hitt, 2003; Brynjolfsson & Yang, 1996). Further, studies have used market value as such a measurement. Researchers have focused on understanding whether IT investment positively affects market performance of organizations by using measures such as total shareholder return (Brynjolfsson & Hitt, 1996; Dos Santos et al., 1993), stock market reaction (Chatterjee, Richardson, & Zmud, 2001; Dehning & Richardson, 2002), and Tobin's q (Bardhan et al., 2013; Bharadwaj et al., 1999).

Studies have frequently measured IT investment in a form of IT budget ratios such as relative investment of IT (IT budget / total assets) (Ho et al., 2011; Li & Ye, 1999) or IT investment intensity (IT budget / total sales) (Chari, Devaraj, & David, 2008; Ravichandran, Liu, Han, & Hasan, 2009) rather than using the IT budgets of each organization since such budgets differ widely by organization size. Additionally, in exploring the role of IT assets such as infrastructure and labor on organizational performance, Aral and Weill (2007) found that investments in different types of IT assets have different effects on organizational performance. Weill (1992) stated that one should break down a single measure for IT investment into multiple measures due to its broadness. Rai, Patnayakuni, and Patnayakuni (1997) broke down IT budget into four key elements (hardware, software, telecommunication, and IS staff). Bharadwaj et al. (1999) identified different types of IT investment and suggested that future research should investigate the impact of different types of IT investment. Lee and Menon (2000) conducted one of the first studies that investigated IT capital and IT labor separately. They reported that, while IT capital improved productivity, IT labor had no effect on productivity. Piccoli and Ives (2005) reviewed the literature on IT-dependent strategic initiatives and categorized IT resources as IT assets (IT infrastructure and information repositories) and IT capabilities (technical skills, IT management skills and relationship assets). Bulchand-Gidumal and Melián-González (2011) showed that IT human resources and IT physical resources played a key role in generating impact in organizations. Using the Cobb-Douglass production function, prior studies have commonly explored and showed the role of IT capital and IT labor on organizational productivity (Bhansali & Zhu, 2008; Brynjolfsson & Hitt, 1995; Hitt & Brynjolfsson, 1996; Tambe & Hitt, 2012).

Prior literature has shown that IT investment has different effects on each facet of organizational performance. Studies that focused on market value found a positive relationship between IT investment and market value. Dos Santos et al. (1993) separated IT investments as innovative and follow-up or non-innovative investments and found that markets reacted differently to the announcements of different types of IT investment. While non-innovative IT investment had no impact on market value, innovative IT investment increased market value. Bharadwaj et al. (1999) tested this relationship using Tobin's q and found that IT investment was positively associated with future market value potential. Dehning and Richardson (2002) concluded that IT investment increased market value of an organization from five times to 20 times of the amount the organization spent on IT. Kohli et al. (2012) used Tobin's q to measure market value in healthcare industry and Bardhan et al. (2013) investigated the role of IT investment and R&D investment interaction on Tobin's q ; both studies confirmed Bharadwaj et al.'s (1999) findings. Similarly, Mithas and Rust (2016) examined the joint effect of IT strategy and IT investment on Tobin's q and found significant results.

On the other hand, previous studies on the relationship between IT investment and organizational profitability have had varied results because other external factors such as the environment, strategy, and managers influenced the relationship. Hitt and Brynjolfsson (1996) found that IT investment had no effect on organizational profitability because many other factors affected profitability and IT investment explained only a small portion of the variance of profitability. Li and Ye (1999) examined the role of environmental, strategic and managerial context in the relationship between IT investment and organizational profitability. They concluded that IT investment led to better profitability for organizations that operated in a more-

dynamic environment with an externally oriented strategy. Mithas et al. (2012) divided organizational profitability into two dimensions: revenue growth and cost reduction. They found that IT investment had a significant effect on revenue growth but not on cost reduction.

Nevertheless, the extant literature has found contradicting results about the role of IT investment on organizational productivity. Early studies did not find a connection between IT investment and organizational productivity. Solow (1987) characterized these results as “we see computers everywhere except in the productivity statistics”. Scholars have come to refer to these conflicting results as the IT productivity paradox (Shao et al., 2010). Later studies have shown that IT investment has a positive impact on organizational productivity. Brynjolfsson and Hitt (1995) found that both IT capital and labor expenditures had a significant effect on productivity. Brynjolfsson and Hitt (2003) examined the role of computerization on productivity. They found that computerization had a more-significant effect on productivity in the long term (five to seven years) than in the short term (one year) than. Aral and Weill (2007) investigated the role of different IT investment allocations and IT capabilities on performance and found that different types of IT assets led to different performance outcomes. Yao et al. (2010) studied the influences of organization context on the relationship between IT investment and organizational productivity. They concluded that organizations with a higher level of vertical integration in a durable goods industry realized improved labor and administrative productivity. Dedrick, Gurbaxani, and Kraemer (2003) reviewed more than 50 published research papers on computers and productivity. They concluded that the effect of IT investment on organizational productivity varied among organizations due to the differences in organizational capital. In other words, IT creates business value under certain conditions. Therefore, we need to understand why different organizations experience different performance in terms of productivity (Barua et al., 2010).

While an important component of corporate governance, IT governance constitutes the weakest link in organizations' overall governance structure (Brown & Grant, 2005). Recent studies have investigated the impact of IT governance on the business value of IT (Buchwald et al., 2014; Gu, Xue, & Ray, 2008; Lunardi, Becker, Maçada, & Dolci, 2014; Pang, 2014). These studies have emphasized the importance of IT governance for organizations. However, we do not know exactly how IT governance impacts the relationship between IT investment and organizational productivity. Thus, in this study, we examine the effects of IT governance on the relationship between IT investment and organizational productivity. In line with the literature, we use value added as a measure for organization productivity (Brynjolfsson & Hitt, 1995; Rai et al., 1997; Tambe & Hitt, 2012). We also divide IT investment into IT infrastructure intensity and IT labor intensity to examine their impacts separately (Bulchand-Gidumal & Melián-González, 2011; Lee & Menon, 2000; Piccoli & Ives, 2005; Rai et al., 1997). We use intensity measures to capture IT investment because the size of each organization differs significantly in the sample—the normalization helps avoid heteroskedasticity (Shin, 2001).

2.2 Importance of IT Governance

Given the crucial roles that IT plays in organizations, IT governance has received increasing attention in both research and practice (De Haes & Van Grembergen, 2008). Today, managers look at IT governance as a vital way to guarantee returns on their investment and improve organizational performance (Jacobson, 2009) because the way organizations manage IT—not simply its presence—ensures returns. Studies in the literature have defined IT governance in various ways, and Table 1 presents a sample of such definitions.

Each definition focuses on certain aspects of IT governance, such as environmental influence (Schwarz & Hirschheim, 2003), decision rights and accountability (Weill & Ross, 2004; Weill & Vitale, 2001), structure of decision making processes (Campbell, McDonald, & Sethibe, 2010; Luftman, 1996; Sambamurthy & Zmud, 1999; Van Grembergen & De Haes, 2009), organizational capability (Van Grembergen, 2002), and joint responsibility for internal and external control (Wijsman, Neelissen, & Wauters, 2007). All IT governance definitions share the common denominator that board members and executive officers have the responsibility to define and share the structure of relationships, processes, and mechanisms to manager IT resources.

Therefore, one can classify IT governance's objectives into three major categories: 1) supporting an environment for developing, exercising, and exploiting IT resources and capabilities; 2) providing a framework for fruitfully exploring and explicating relationships between the IT function and the rest of the company; and 3) identifying and underpinning a series of organizational routines and procedures through which the organization achieves the business value of IT and contains IT risk (Marshall, McKay, &

Prananto, 2005). When applied correctly, IT governance puts CIO and other senior managers in a powerful position to affect IT strategy (Li & Ye, 1999; Weill & Ross, 2004). Consequently, successful IT governance creates a legitimate environment for IT functions. As a result, the realized value of IT increases while the IT risks decreases.

Table 1. IT Governance Definitions

Study	IT governance definitions
Brown & Magill (1994)	IT governance describes the locus of responsibility for IT functions.
Luftman (1996)	IT governance is the degree to which management defines and shares the authority for making IT decisions, and the processes managers in both IT and business organizations apply in setting IT priorities and the allocation of IT resources.
Sambamurthy & Zmud (1999)	IT governance refers to the patterns of authority for key IT activities.
Van Grembergen (2002)	IT governance refers to the organizational capacity that the board, executive management, and IT management exercise to control the formulation and implementation of IT strategy and, in this way, ensure the fusion of business and IT.
Weill & Vitale (2001)	IT governance describes a firm's overall process for sharing decision rights about IT and monitoring the performance of IT investments.
Schwarz & Hirschheim (2003)	IT governance comprises IT-related structures or architectures (and associated authority patterns) that organizations implement to successfully accomplish (IT-imperative) activities in response to an enterprise's environment and strategic imperatives.
Weill & Ross (2004)	IT governance specifies the decision rights and accountability framework to encourage desirable behavior in using IT.
Wijisman et al. (2007)	IT governance is the joint responsibility of the executive management level of an organization and its supervisor(s) for 1) strategic planning and 2) internal control of the organization's deployment of IT and for 3) external accountability and 4) external supervision of the organization's deployment of IT
Bowen, Cheung, & Rohde (2007)	IT governance is the responsibility of executives and the board of directors and comprises the leadership, organizational structures, and processes that ensure the enterprise's IT sustains and extends the organization's strategies and objectives
Campbell et al. (2010)	IT governance refers to the structure of relationships, processes, and mechanisms used to develop, direct, and control IT strategy and resource allocation so as to achieve the goals and objectives of an enterprise. It is a set of formal processes that focuses on balancing the risk and return aspects of IT investment so as to consistently add value to the organization.
Van Grembergen & De Haes (2009)	Enterprise governance of IT represents an integral part of corporate governance and addresses the definition and implementation of processes, structures, and relational mechanisms in an organization that enable both business and IT people to execute their responsibilities to support business/IT alignment and create business value from IT-enabled business investments.

Prior research has approached the IT governance problem from different angles. While some studies have investigated the antecedents of IT governance such as board attributes, organizational factors, external environment, internal context, and top management commitment (Brown & Magill, 1994; Buchwald et al., 2014; Jewer & McKay, 2012; Sambamurthy & Zmud, 1999), other studies have focused on the outcomes of IT governance such as IT-enabled enterprise adaptability, business and IT alignment, performance outcomes, and outsourcing decisions (Ali & Green, 2012; Bart & Turel, 2010; De Haes & Van Grembergen, 2008; Turel & Bart, 2014). One can categorize the IT governance literature into two main streams: 1) the design of decision making structure and 2) senior management (and/or board) involvement in IT governance (Brown & Grant, 2005; Jewer & McKay, 2012). The former focuses on managerial-level decision making, while the latter explores senior management's involvement in IT governance. The majority of work has focused on the first stream—only a small number of studies have tested the impact that decision making structure has on organizational performance (Bart & Turel, 2010; Brown & Grant, 2005; Jewer & McKay, 2012). Therefore, we investigate whether and to what extent both decision making structure and senior management involvement moderate the relationship between IT investment and organizational productivity.

2.2.1 Decision Making Structure Mechanisms

A review of IT governance literature reveals that researchers have proposed many different IT governance frameworks to design IT governance's decision making structure (Bowen et al., 2007; Turel & Bart, 2014; Wilkin & Chenhall, 2010; Willson & Pollard, 2009). Among these frameworks, the most frequently used for IT governance include Control Objectives for Information and Related Technology (COBIT), Information Technology Infrastructure Library (ITIL), Committee of Sponsoring Organizations of the Treadway Commission (COSO), Val IT, Risk IT, Prince2, Project Management Body of Knowledge (PMBOK), International Federation of Accountants (IFAC), and Sarbanes-Oxley Act (SOX) (for a recent review, see Brown & Grant, 2005; Wilkin & Chenhall, 2010). These IT governance frameworks focus on helping organizations to govern IT. Yet, each may not apply in all circumstances (Bart & Turel, 2010). Weill and Ross (2004) have argued that organizations must implement well-designed, well-understood, and transparent mechanisms to achieve IT governance effectiveness, which, in turn, positively affects organizational performance. They interviewed 256 CIOs and proposed an IT governance framework with the 15 most common IT governance mechanisms, which they categorized into three main types: 1) decision making structures, 2) alignment processes, and 3) communication approaches.

Results of prior research on decision making structure indicate that the misalignment between IT governance mechanisms and corporate governance reduces the influence that IT investment has on performance (Gu et al., 2008). On the other hand, the reporting structure between CIOs and chief executive officers (CEOs) (Banker, Hu, Pavlou, & Luftman, 2011) positively influences the impact that IT investment has on performance. Therefore, by using effective IT governance mechanisms, organizations can benefit more from their IT investments. Additionally, two recent studies have examined the moderating role of IT governance mechanisms on overall organizational performance. First, Pang (2014) focused on public sector organizations and concluded that the influence of IT investment was higher when legislative controls existed. Second, Lunardi et al. (2014) found that IT governance adaptation had a positive impact on IT investment performance through measuring pre- and post-adaptation performance of Brazilian organizations.

Our study differs from previous research on decision making structure in three ways. First, Pang (2014) investigated only the impact that IT governance has on cost efficiency and did not provide any insight about the effect of IT governance on any traditional organizational performance measures such as productivity. Second, although these studies investigated the role of mechanisms such as IT-related legislative committee (Pang, 2014) or IT strategy committee (Lunardi et al., 2014), they did not consider decision making structure mechanisms. Despite the importance of decision making structure, little work has investigated its impact on the relationship between IT investment and organizational productivity. Thus, we fill this void. Because our study focuses on the decision making structure's design, we use the seven mechanisms of decision making structures that Weill and Ross (2004) identified. Third, prior studies on IT governance mechanisms have investigated the impact of IT investment as one aggregate measure. We divide IT investment measure into two subcategories (IT infrastructure intensity and IT labor intensity) to investigate the differences between IT investment types. One needs to break the measure into several such categories since recent studies show that different IT investments (such as infrastructure and labor) have different impacts on organizational performance (Bharadwaj et al., 1999; Bulchand-Gidumal & Melián-González, 2011).

Similarly, contingency theory emphasizes the impact that contingencies have on organizational performance. Contingency refers to "any variable that moderates the relationship between organizational attributes and performance" (Morton & Hu, 2008). Thus, contingencies influence the relationship between any organizational characteristics (such as IT investment) and organizational performance. Initially, contingency theory focused on the fit between organizational structure and environmental contingencies (Brown & Magill, 1994; Xue, Liang, & Boulton, 2008). However, in today's complex business environment, internal contingencies (e.g., structural formalization and technology) also affect the relationship between IT investment and organizational performance (Weber, Otto, & Österle, 2009). Therefore, contingency theory should help to explain the effect that IT governance has on the relationship between IT investment and organizational performance.

Additionally, contingency theory argues that no best way of organizing and leading an organization exists (Fiedler, 1964). The effectiveness level of a leadership or organizational style can differ under diverse conditions. Therefore, the success of the leadership or organizational style depends on some internal and external constraints (Fiedler, 1964). In other words, the "fit" between organizational structure and contingencies determines an organization's performance (Dale Stoel & Muhanna, 2009; Lee, 2008;

Morton & Hu, 2008). For example, when an organization adopts software to increase its effectiveness, the organization's IT infrastructure, labor constraints, and IT governance will limit the software's impact. The software's effectiveness will increase dramatically when an organization has a better fit between IT governance and the environment. Thus, drawing from contingency theory and the relevant literature, we propose that:

- H1a:** An effective decision making structure in IT governance positively moderates the relationship between IT infrastructure intensity and organizational productivity.
- H1b:** An effective decision making structure in IT governance positively moderates the relationship between IT labor intensity and organizational productivity.

2.2.2 Role of Senior Management in IT Governance

How senior management involvement in IT governance influences organizational performance represents a key issue that the IS literature discusses (Ali & Green, 2012). IT governance research has investigated what effect manager practices have on an organization's productivity level and how managers make IT investment decisions (Ravichandran et al., 2009). The IT governance literature shows that senior management commitment to IT governance has a positive impact on organizational performance.

One can categorize the extant literature on senior management involvement in IT governance as normative and descriptive research (Jewer & McKay, 2012). Normative research makes suggestions regarding the role of senior management in IT governance, whereas descriptive research investigates how managers actually participate in IT governance. Normative research shows that senior management commitment can be a major success factor for IT governance (Buchwald et al., 2014). Researchers have argued that senior managers can initiate IT investment decision making processes (Weill & Olson, 1989) such that a CIO's decision making process impacts the relationship between IT functions and organizational performance (Preston, Chen, & Leidner, 2008). Similarly, an organization's CEO's participation in its IT steering committee and high-level IT governance board positively impacts organizational performance (Raghunathan, 1992; Turel & Bart, 2014). Further, based on their findings from conducting a case study on one large multi-national organization in Australia, Willson and Pollard (2009) suggest that the success of IT governance depends on the level of involvement and commitment of senior managers. In contrast, descriptive research shows that IT governance involves little actual senior management involvement (Andriole, 2009). Thus, managers' attitudes towards IT investment and their involvement in the IT decision making process may affect the impact that IT investment has on productivity. However, we do not clearly understand how exactly senior management involvement affects the relationship between IT investment and organizational productivity. Weill and Ross (2004) developed a framework to clarify the role of senior management involvement in IT governance. They defined six organizational structures for IT governance and studied the allocation of the decision rights of five key IT decisions among C-level executives, IT executives, and business unit leaders based on the six organizational structures. The results suggest that no single best structure to govern IT exists but that, when senior managers take time to design, implement, and communicate IT governance processes, organizations realize more value from IT and that senior management awareness of IT governance best indicates its effectiveness.

Furthermore, we use strategic choice perspective to theorize senior management involvement in IT governance. We define strategic choice as the process that decision makers such as managers use to evaluate alternatives and selecting a course of action (Harrison & Pelletier, 1997). In other words, managers have options to choose from a set of alternative business strategies. Therefore, strategic choice theory focuses on managers and the impact that their decisions have on organizational success or failure (Child, 1972). According to the strategic choice theory, the environment determines part of an organization's structure, and an organization's managers have a critical role in determining its ultimate structure based on their preferences (Hsing & Souza, 2012).

Hsing and Souza (2012) studied the effects of management practices on IT architecture decisions and found support for the strategic choice theory. Shin (2001) studied the importance of strategic choice in terms of vertical disintegration and diversification on the IT investment-organizational performance relationship and found that strategic choice improved the effect that IT investment has on performance. These studies argued that IT management decisions would affect organizational performance; however, they did not consider the impact that IT governance has on the relationship between IT Investment and performance. In addition, Willson and Pollard (2009) found that senior management involvement

increased the success of IT governance. Raghunathan (1992) found that a CEO's participation in an IS steering committee increased the latter's positive influence on IT's alignment with organizational structure. Prior research's findings indicate that senior management involvement may significantly impact how well organizations realize benefits from their IT investment due to managers' strategic choices. If managers make IT investment decisions that align with their organization's structure, that investment should have a higher positive impact on the overall organizational performance. Therefore, drawing from prior literature and strategic choice theory, we propose that:

H2a: Senior management involvement in IT governance positively moderates the relationship between IT infrastructure intensity and organizational productivity.

H2b: Senior management involvement in IT governance positively moderates the relationship between IT labor intensity and organizational productivity.

Figure 1 illustrates the proposed framework.

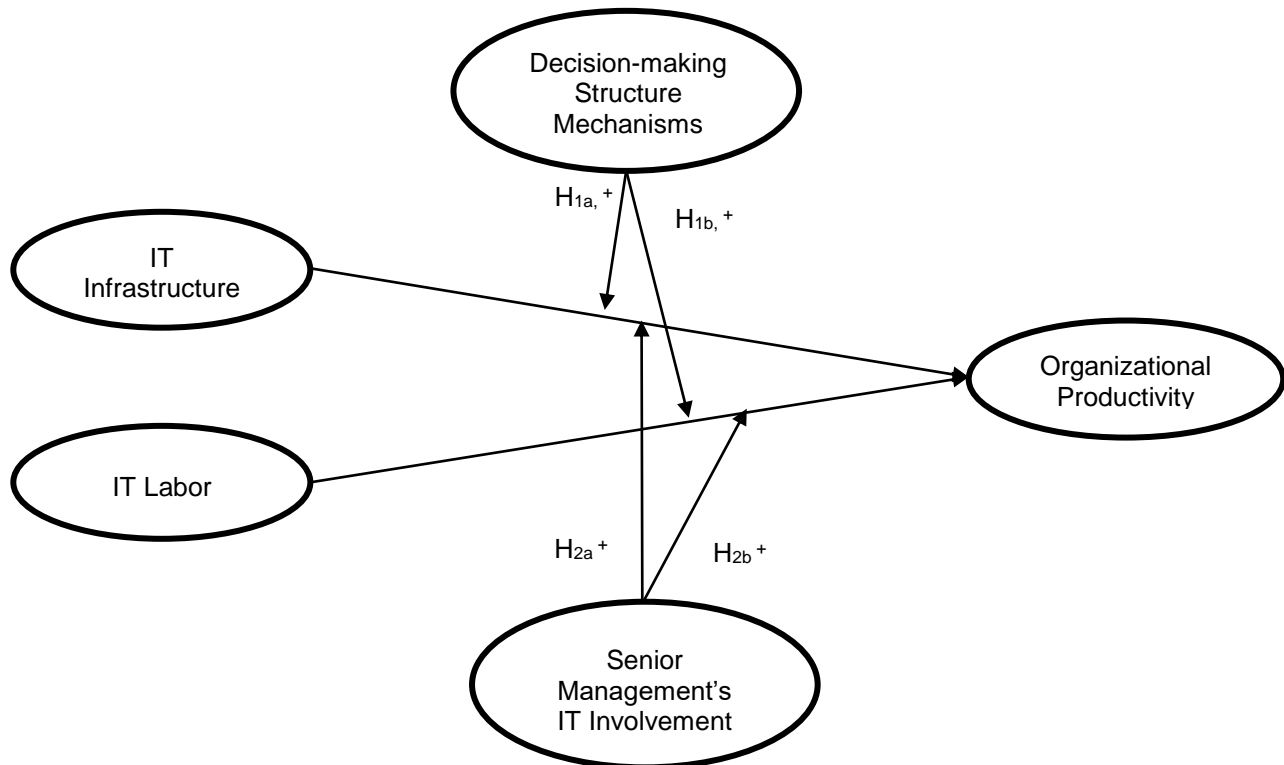


Figure 1. Proposed Framework

3 Data Collection and Analysis

3.1 Data Collection

We used a superset of the data that Bhansali and Zhu (2008) used, though they examined only the direct relationship between IT investment and organizational productivity. In this study, we focus on the impact that IT governance practice has on the IT investment and organizational productivity relationship. Additionally, we use intensity to measure IT investment, which research has proven to better suit regression analysis.

The dataset includes the estimated IT expenditure of 329 large companies for 2005. The second author collected the data by phone interviews using a questionnaire, which was distributed to the participants before interviews. Approximately 600 organizations participated in the phone interviews. Since some of these organizations were privately owned or provided unreliable/incomplete data, we could use only 347 questionnaires. Further, due to mergers, acquisitions, bankruptcies, and missing data, 230 organizations remained in the sample.

The organizations had US\$17.58 billion in sales on average in the sample period and around \$4.04 trillion in sales in total. An average organization spent US\$318 million annually on IT, of which IT labor expenditure accounted for more than a third. Approximately 25 percent of the observations come from the metal-related manufacturing sector, the largest sector in the sample but not overwhelmingly dominant. Both the wood-related manufacturing and the finance and insurance sectors account for more than 10 percent of the observations. Tables 2 and 3 report the sample's statistics and industry profile, respectively.

Table 1. Sample Statistics (N = 230)

Variables	Total			Average organization
	In billions	% gross output	% value added	In millions
Sales	\$4,042.4	100.00%	456.36%	\$17,575
Value added	\$885.8	21.91%	100.00%	\$3,851
IT infrastructure expenditure	\$32.3	0.80%	3.65%	\$148.9
IT labor expenditure	\$25.4	0.63%	2.87%	\$110.5
Market cap	\$5,357.4	132.53%	604.81%	\$23,293

Table 3. Industry Profile based on Two-digit NAICS Code

Industry	N	%
Agriculture	1	0.44
Mining	3	1.30
Utilities	16	6.96
Construction	4	1.74
Manufacturing (food, beverage, textile, apparel, leather)	7	3.05
Manufacturing (wood, paper, petroleum, chemical, plastic, nonmetallic products)	35	15.22
Manufacturing (primary and fabricated metal industries, etc.)	57	24.78
Wholesale trade	5	2.17
Retail trade (motor vehicle, furniture, electronics, building, food and beverage, etc.)	11	4.78
Retail trade (sporting, general merchandise, miscellaneous, non-store)	6	2.61
Transportation and warehousing (air, rail, water, truck, transit, pipeline, scenic, etc.)	6	2.61
Transportation and warehousing (postal, courier, warehousing)	3	1.30
Information	14	6.09
Finance and insurance	28	12.17
Real estate and leasing	5	2.17
Professional, scientific and technical services	8	3.48
Administrative and support, waste management and remediation services	5	2.17
Health care and social assistance	5	2.17
Arts, entertainment, and recreation	2	0.87
Accommodation and food services	8	3.48
Non-classifiable establishments	1	0.44
Total	230	100

The dataset has some superior features relative to the datasets that other studies have used. The interviews allowed for opportunities to verify the values against those of previous years. As such, the accuracy of the data is likely higher than the ones obtained from secondary sources based on questionnaire surveys. In addition, the sample has a more balanced industry profile; thus, the results should represent a broad cross-section of the economy.

However, the data has certain limitations that one should keep in mind. The organizations self-reported their IT-related information, and, with any self-reported data, bias can influence the results. In addition, the data may have a sample selection bias. However, the relatively large sample size helps to mitigate such bias (Bhansali & Zhu, 2008; Brynjolfsson & Hitt, 1996).

3.2 Measurement

We adopted the constructs from Hitt and Brynjolfsson (1996) and Kudyba and Diwan (2002). We measured independent and moderating variables (see Section 3.2.2 to 3.2.4) using data collected through the interviews. We retrieved the dependent and control variables (industry and market capitalization) from COMPUSTAT. Table 4 defines the variables that we used in the study.

Table 4. Definition and Construction of Variables

Variable	Definition / construction	Source
Value added	Sales minus cost of goods sold and general/administrative expenses	Compustat
Senior management's IT involvement	Senior management's involvement in the IT decision making process in the organization	This study
Decision making structure	Organizational structures that locate decision making responsibilities according to intended archetypes	This study
IT infrastructure intensity	Total amount spent on IT infrastructure divided by total sales	This study
IT labor intensity	Total amount spent on IT labor divided by total sales	This study
Industry	Industry sector based on two-digit NAICS code	Compustat
Market cap	Sum of all issue-level market values (trading and non-trading issues).	Compustat

3.2.1 Organizational Productivity

Researchers have commonly used value added to measure organizational productivity (see Section 2.1). Since it may be sensitive to industry structure differences, we controlled for industry in our analyses. Using each company's name and its stock ticker symbol that interview respondents reported, we match the records in COMPUSTAT to obtain relevant financial data for each company. Additionally, we collected the two-digit NAICS code for each organization to identify their respective industries. We computed value added for 2005 by subtracting the cost of goods sold and general and administrative expenses from total sales. Then, we transformed all values into natural logarithmic values to reduce the skewness of the distribution.

3.2.2 IT Infrastructure and Labor Intensity

As we mention in Section 2.1, intensity measures better suit our study because they can deal with heteroskedasticity. IT investment intensity measures the degree to which an organization operationally depends on technology. The higher the ratio, the more the organization depends on technology regardless of its size. We used two investment intensity measures in this study—IT infrastructure intensity and IT labor intensity—which measure the operating dependency on IT infrastructure and IT labor, respectively. The interviews asked respondents to provide their organization's actual IT infrastructure and labor expenditures for 2005. To calculate these two measures, we divided each organization's respective IT expenditure by their total sales. After computing these intensity measures, we used logarithmic transformation to reduce the skewness of their distribution. Additionally, we centered the variables to avoid multi collinearity problems that can often occur in regression models with moderating effects.

3.2.3 Decision Making Structure Mechanisms

We captured decision making structure with the following five (from seven total) IT governance mechanisms that Weill and Ross (2004) developed:

- Executive committee (most senior management committee in the company).
- IT council comprising business and IT executives.
- IT leadership committee comprising IT executives.
- Process teams with IT members.
- Business/IT relationship managers.

The interviews asked respondents to grade the five decision making structure mechanisms of IT governance from on a five-point scale (1 = ineffective; 5 = effective) to show each mechanism's effectiveness in creating business value from IT for the year 2005. We excluded two mechanisms (capital approval committee and architecture committee), which CIOs in Weill and Ross's (2004) study ranked the lowest in terms of effectiveness, from our study because most of the respondents indicated that they did not use these two mechanisms.

After collecting the data, we computed decision making structure measure by summing the score for each decision making structure mechanism. Subsequently, we centered the decision making structure variable to avoid any multicollinearity possibility.

3.2.4 Senior Management's IT Involvement

The literature has not established a scale to measure senior management involvement. Thus, to measure it, we used the following six items:

- Senior management attends IT council meetings and does not send a nominee.
- Senior management works with the IT group to specify the required infrastructure in business terms.
- Senior management requires carefully considered business cases for investments with measures and responsibilities identified.
- Senior management supports the strategic uses of IT by providing seed funding not requiring traditional net present value financial justifications.
- Senior management encourages post implementation reviews that are not witch-hunts and facilitate the gathering and dissemination of the lessons learned.
- Senior management encourages, funds, and actively supports training in the use of IT.

The interviews simply asked respondents to consider the part of the company they knew the best and to grade the characteristics of their senior managers from -3 (worst you have seen) to +3 (best you have seen) with 0 representing the industry average for the year 2005.

Like decision making structure, we captured senior management involvement by summing the scores of the six items, and we centered the values to avoid multicollinearity issues.

3.3 Data Analysis

Extant literature on the business value of IT has used the economic theory of production to estimate the impact that IT investment (input) has on productivity (output) (Brynjolfsson & Hitt, 1995, 2003; Ramirez, Melville, & Lawler, 2010). Cobb-Douglass assumes that one can specify the organizational output (Q) model as a function (F) of organizational inputs (i). Prior studies commonly used non-IT capital (K), IT capital stock (C), and IT labor (L) (Bhansali & Zhu, 2008). We represented the production function as:

$$Q = F(C, K, L) \quad (1)$$

We wrote the translog (transcendent logarithmic) form of the production function as:

$$\text{Log}(Q) = \beta_1 \text{log}(C) + \beta_2 \text{log}(K) + \beta_3 \text{log}(L) + \varepsilon \quad (2)$$

Previous research has commonly used value added, which one can describe as "[the] value added by a firm when turning inputs into products or services (output) to be sold in the marketplace" (Ramirez et al., 2010, p. 422), to measure the production outcome (Bhansali & Zhu, 2008; Brynjolfsson & Hitt, 2003). Researchers have often defined it as a function of IT capital and IT labor. Ramirez et al. (2010) have expanded this production function by including business process redesign (BPR), interaction terms, and control variables and defined the production function as:

$$\text{Log}(VA) = \beta_1 \text{log}(C) + \beta_2 \text{log}(K) + \beta_3 \text{log}(L) + \beta_4 \text{BPR} + \beta_5 \text{BPR} * \text{log}(C) + \text{Controls} + \varepsilon \quad (3)$$

Drawing on extant literature, we used IT infrastructure intensity (II) and IT labor intensity (IL) to measure IT capital and IT labor, respectively. We did not include non-IT capital in to our production function because it falls outside our scope for this research. We argue that IT governance (ITG) plays a critical role in the production outcome. Additionally, the production function may also vary due to the differences in the industry (IN) in which organizations operate and their market capital (MC). Due to the high correlation

between IT infrastructure intensity and IT labor intensity, we added these two inputs into the function separately. Therefore, for our purposes, we expressed two organizational productivity functions as:

$$\text{Log(VA)} = B_0 + B_1 \text{IN} + B_2 \text{Log(MC)} + B_3 \text{Log(IL)} + B_4 \text{ITG} + B_5 \text{Log(IL)*ITG} + \varepsilon \quad (4)$$

and

$$\text{Log(VA)} = B_0 + B_1 \text{IN} + B_2 \text{Log(MC)} + B_3 \text{Log(IL)} + B_4 \text{ITG} + B_5 \text{Log(IL)*ITG} + \varepsilon \quad (5)$$

As we state in Section 2.2, decision making structure (DMS) represents an important part of IT governance. Therefore, we investigated the effect that decision making structure has on the organizational productivity. To test the H1a and H1b, we specified our estimation models as:

$$\text{Model 1: Log(VA)} = B_0 + B_1 \text{IN} + B_2 \text{Log(MC)} + B_3 \text{Log(IL)} + B_4 \text{DMS} + B_5 \text{Log(IL)*DMS} + \varepsilon \quad (6)$$

and

$$\text{Model 2: Log(VA)} = B_0 + B_1 \text{IN} + B_2 \text{Log(MC)} + B_3 \text{Log(IL)} + B_4 \text{DMS} + B_5 \text{Log(IL)*DMS} + \varepsilon \quad (6)$$

While model 1 tested the moderating effect that decision making structure has on the relationship between IT infrastructure intensity and productivity (H1a), model 2 examined the moderating effect that decision making structure has on the relationship between IT labor intensity and productivity (H1b). Similarly, senior management's IT involvement (SMI) also may affect organizational productivity.

At this point, we need to clarify the conceptual distinction between decision making structure and senior management involvement. Decision making structure comprises the organizational mechanisms that organizations gathered to create the processes managers to govern IT investments. Senior managers' behaviors have no effect on these mechanisms. On the other hand, senior management involvement accounts for the attitude of senior managers toward IT investment decisions. In other words, senior management involvement focuses on understanding how much senior managers value IT and encourage its use. Therefore, decision making structure may affect senior managers' attitude or vice versa. Hence, we treated these two moderators separately in the analysis. To test H2a and H2b, we specify our estimation models as:

$$\text{Model 3: Log(VA)} = B_0 + B_1 \text{IN} + B_2 \text{Log(MC)} + B_3 \text{Log(IL)} + B_4 \text{SMI} + B_5 \text{Log(IL)*SMI} + \varepsilon \quad (7)$$

and

$$\text{Model 4: Log(VA)} = B_0 + B_1 \text{IN} + B_2 \text{Log(MC)} + B_3 \text{Log(IL)} + B_4 \text{SMI} + B_5 \text{Log(IL)*SMI} + \varepsilon \quad (8)$$

Model 3 assesses the moderating effect that senior management involvement has on the relationship between IT infrastructure intensity and productivity (H2a), whereas model 4 assess the moderating effect that senior management involvement has on the relationship between IT labor intensity and productivity (H2b).

We used a three-step hierarchical regression analysis to estimate all four models. Hierarchical regression analysis is useful when prior literature or theory identifies a sequence of variables that one needs to add to the regression equation. Each step includes a set of variables that one groups together conceptually based on the logic of one's research (Weill, 1992). Hence, by using hierarchical regression allows, we could identify the effects of the set of control variables, independent variables, and moderating variables as a whole and individually. In other words, hierarchical regression assesses the impact of each set of variables on the dependent variable. For this study, the analysis's three steps showed the impact of the control variables, the direct effect of the independent and moderating variables, and the interaction of the independent and moderating variables, respectively. This way, we could determine whether the moderating effect remained significant when we controlled for the first two steps. Further, we used the list-wise case-exclusion method to ignore missing values.

4 Results

Before estimating the models, we checked for autocorrelation. Table 5 displays the correlation matrix. All correlations were below 0.7 except for IT infrastructure and IT labor investments. Low correlations show that no auto-correlation existed. The highest correlation among other variables was between value added and market capital (0.693).

Table 5. Correlation Coefficients

	Variables	1	2	3	4	5	6
1	Value added	1.000					
2	IT infrastructure intensity	-0.056	1.000				
3	IT labor intensity	-0.053	0.979***	1.000			
4	Market cap	0.693***	-0.058	-0.055	1.000		
5	Decision making structure	-0.119**	-0.029	-0.024	-0.011	1.000	
6	Senior mgmt.'s involvement in ITG	-0.047	0.090	0.079	-0.007	-0.073	1.000

** p < 0.05, *** p < 0.01

To test the possibility of multicollinearity, we calculated the variance inflation factors (VIFs) for all variables. All VIFs were below 10 (highest = 1.417), which suggests that no multicollinearity problems in models existed. Table 6 presents the regression analysis results for models 1 through 4.

Table 6. Regression Analysis Results¹

Variable / hypothesis	Model 1	Model 2	Model 3	Model 4
Industry	...	...	...	...
Market cap	0.717***	0.728***	0.721***	0.731***
IT infrastructure intensity	-0.170***		-0.185***	
IT labor intensity		-0.155***		-0.169***
Decision making structure	-0.085***	-0.083***		
Senior management's involvement in ITG			-0.031	-0.035
IT inf. x decision making structure (H _{1a})	0.087**			
IT Inf. x senior mgmt.'s involvement in ITG (H _{2a})			0.003	
IT labor x decision making structure (H _{1b})		0.073**		
IT labor x senior mgmt.'s involvement in ITG (H _{2b})				0.012
Adjusted R ²	0.730	0.723	0.716	0.711
F-model	26.848***	25.928***	25.032***	24.530***
Max VIF	1.41	1.39	1.42	1.39

¹ β -estimates are standardized regression coefficients.
 p < 0.05, *p < 0.01.
 We omit industry variables to save space.

Model 1 tested the moderating effect that decision making structure has on the relationship between IT infrastructure investment and organization productivity (H_{1a}). The overall model was significant (F = 26.848, p < 0.001). Interestingly, the results showed that IT infrastructure intensity had a significant and negative effect on organizational productivity. In order to investigate reasons behind such a negative effect, we conducted two separate post hoc analyses. First, we split the data into high IT intensity organizations and low IT intensity organizations using mean split and examined the effects of IT investment on organizational performance for the two groups separately. Second, like the first analysis, we split the data using mean split for DMS and SMI variables to see if the effect of IT investment on organizational performance differed between good governance and poor governance. Results of these post hoc analyses showed that IT investment had a positive impact on organizational performance for high IT intensity organizations with good governance practice, whereas the impact turned negative for low IT intensity organizations with poor governance. These findings confirm Dehning and Richardson's (2002) results: they found that shareholders of high IT intensity organizations positively value IT investment announcements more than low IT intensity organizations. Since the group with low IT intensity and poor governance practice dominated the other group, the overall effect when lumping the two groups together turned out to be negative. Further, of the two control variables, market capital was significant, whereas all industry variables were insignificant.

The interaction coefficient ($II \cdot DMS$), the model's focal point, was positive and significant at the 0.05 level. In order to understand the significance of this finding, we plotted the interaction as the literature suggests (Aiken & West, 1991). We used the mean value of DMS (DMS_{mean}), one standard deviation above DMS (DMS_{high}), and one standard deviation below DMS (DMS_{low}) to substitute DMS in Equation 6. As Figure 2 shows, DMS_{high} had the smallest slope, whereas DMS_{low} had the largest slope, which shows that value added was more stable when an organization had a more efficient decision making structure. Therefore, the results suggest that decision making structure weakens the negative relationship between IT infrastructure intensity and organizational productivity. In other words, organizations with better decision making structure mechanisms achieve higher productivity for every dollar they invest in IT infrastructure. Thus, we found support for H1a.

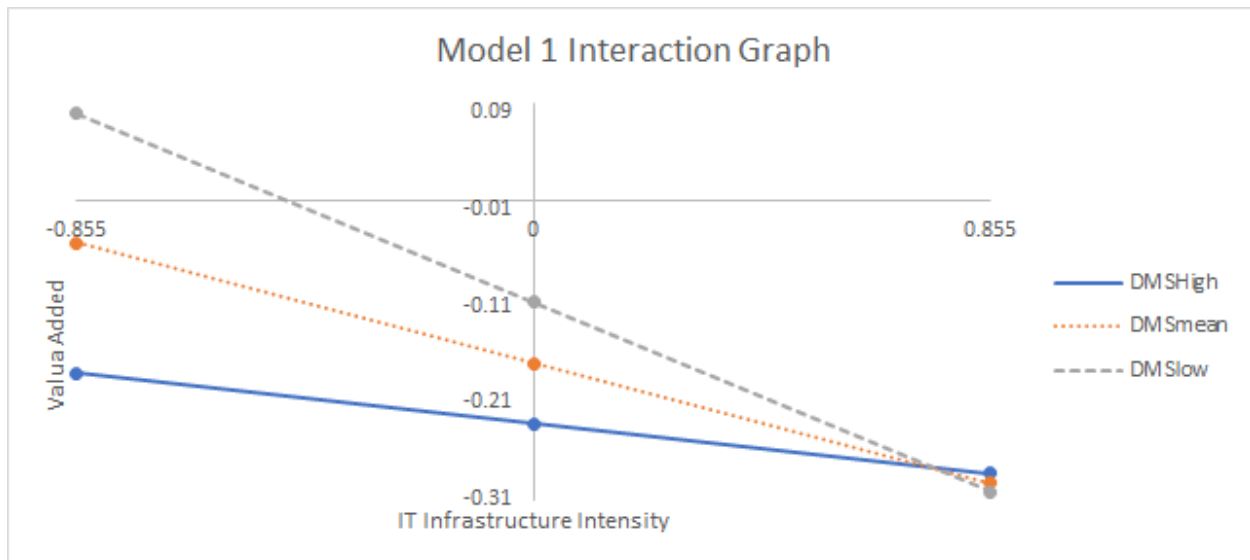


Figure 2. IT Infrastructure Intensity and Decision Making Structure Interaction

Model 2 tested the moderating effects that decision making structure has on the relationship between IT labor and organizational productivity (H1b). We introduced both the IT labor intensity variable and the interaction term of decision making structure with IT labor ($IL \cdot DMS$) to the model. The overall model was significant ($F = 25.928$, $p < 0.001$). The coefficient of the interaction term was positive and significant at the 0.05 level, which supports H1b. We further evaluated this finding by plotting the interaction like model 1. When we used DMS_{high} , DMS_{mean} , and DMS_{low} to substitute DMS in Equation 6, the results suggest that companies with better decision making structure mechanisms also realize more benefit for every dollar investment they make on IT labor than those with poor decision making structure mechanisms (Figure 3). Thus, decision making structure mechanisms help organizations to manage their IT labor investments and derive more benefit from them.

Model 3 tested the moderating effect that senior management involvement has on the relationship between IT infrastructure intensity and organizational productivity (H2a) by including the senior management involvement variable and the interaction of the senior management involvement with IT infrastructure ($II \cdot SMI$). The overall model was significant ($F = 25.032$, $p < 0.001$). The interaction term was positive but not significant at the 0.10 level. Hence, our results do not support H2a. In other words, our results suggest that senior management has no impact on how IT infrastructure investment affects organizational productivity. Although, the moderating effect was insignificant, we plotted the interaction in Figure 4 to confirm that different levels of senior management involvement had no impact on the relationship between IT infrastructure intensity and organizational performance. We used mean value of SMI (SMI_{mean}), one standard deviation above SMI (SMI_{high}), and one standard deviation below SMI (SMI_{low}) to substitute SMI in the Equation 8.

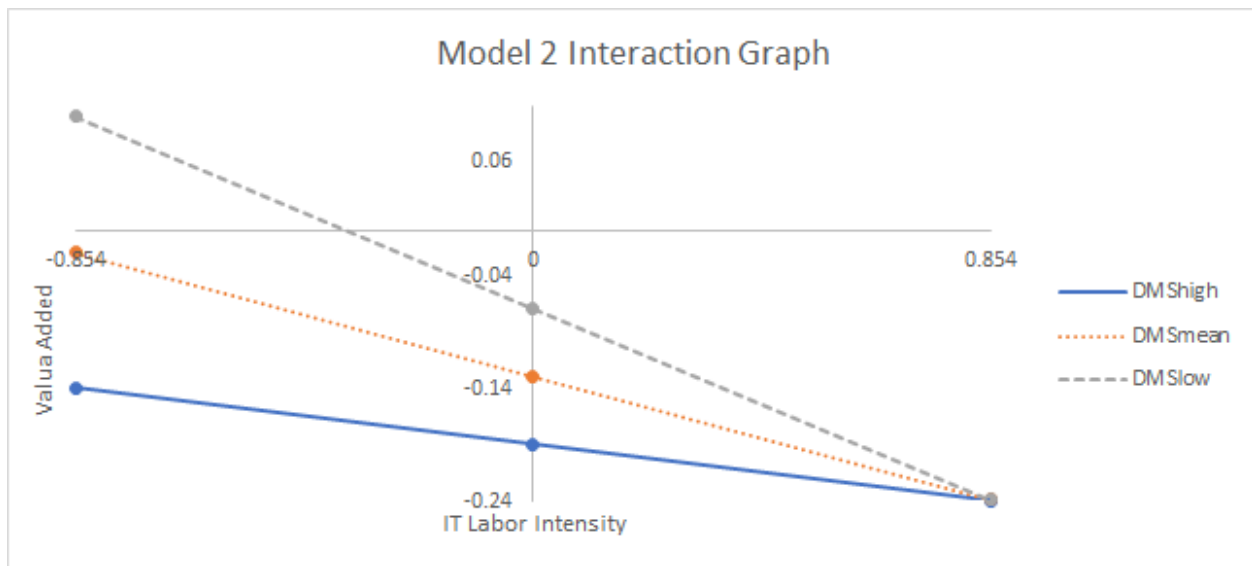


Figure 3. IT Labor Intensity and Decision Making Structure Interaction

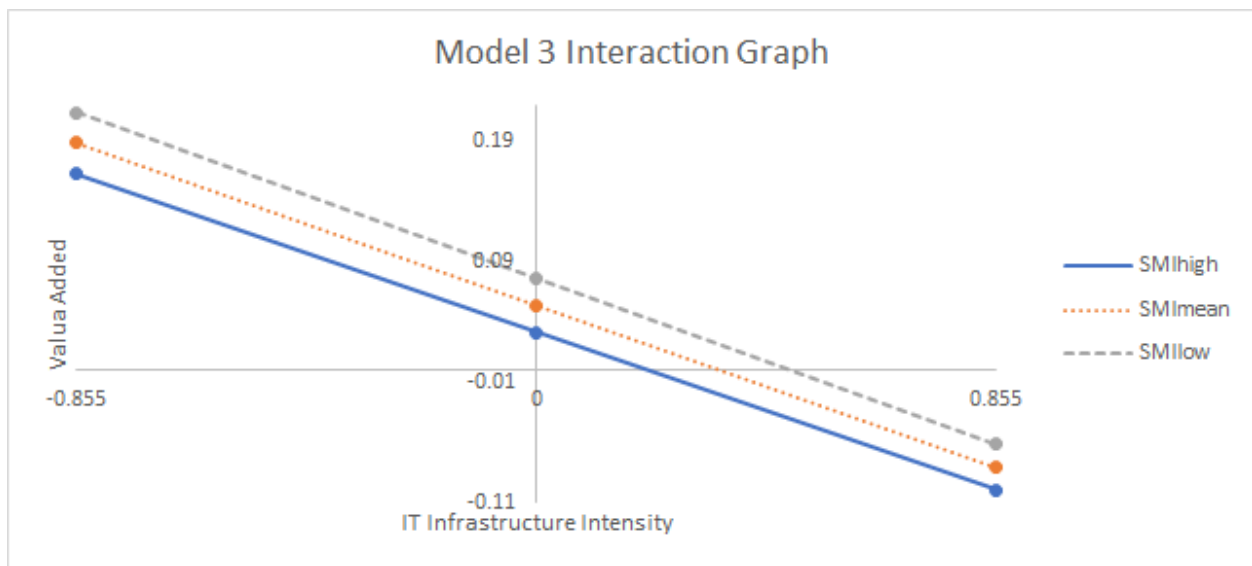


Figure 4. IT Infrastructure Intensity and Senior Management Involvement Interaction

Finally, model 4 tested the moderating effect that senior management involvement has on the relationship between IT labor intensity and organizational productivity (H2b). The overall model was significant ($F = 24.530, p < 0.001$). Like model 3, we included the IT labor intensity variable and the interaction term ($IL * SMI$). The coefficient for the interaction term was positive but not significant at the 0.10 level. Thus, we found no support for H2b. We further confirmed this result by plotting the interaction. As Figure 5 illustrates, increasing or decreasing the level of senior management involvement had no impact on the relationship between IT labor intensity and organizational productivity. In other words, like IT infrastructure intensity, our results suggest that senior management involvement does not affect the impact that IT labor intensity has on organizational productivity.

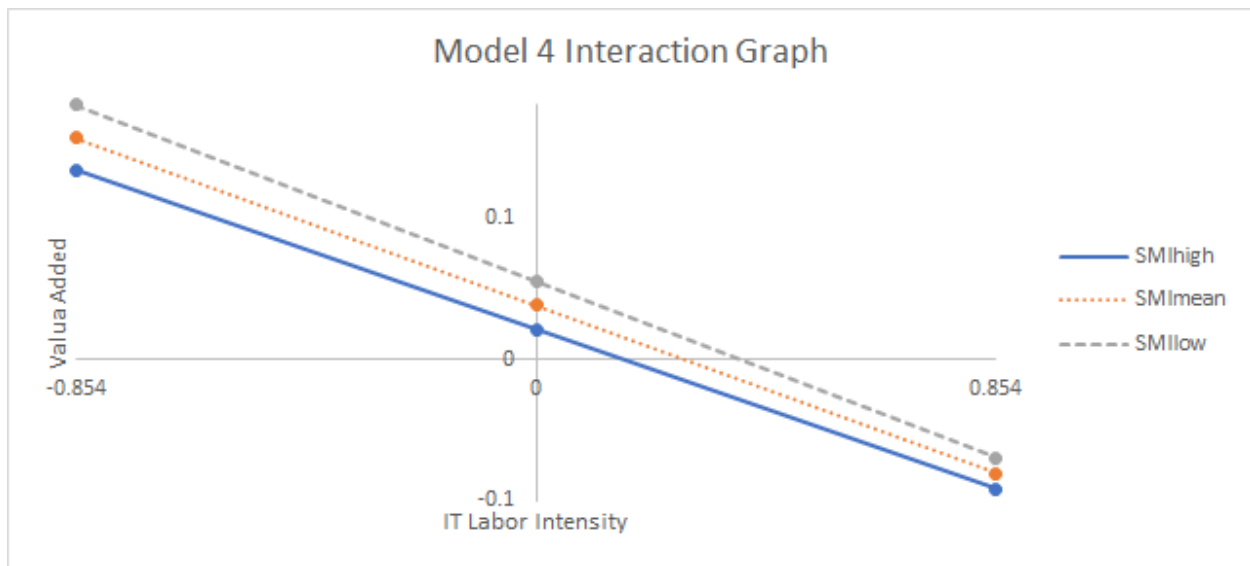


Figure 5. IT Labor Intensity and Senior Management Involvement Interaction

4.1 Sensitivity Analysis

Since we used cross-sectional data, we conducted two different tests for each model to investigate the robustness of our results. First, we used lagging values of the dependent variable to check the robustness of our results. Previous studies have found that IT investment has lagged effects on organizational performance (Lee & Kim, 2006; Schwarz, Kalika, Kefi, & Schwarz, 2010; Yaylacicegi & Menon, 2004)—that the impact that IT investment has on organizational performance might take up to six years to realize. Therefore, we used six separate variables for the lagged value added (one for each year from the first to the sixth) as alternative dependent variables. Second, we tested organizational productivity by using an alternative measure. Prior studies have used different measures, such as labor productivity or total factor productivity (TFP) (Brynjolfsson & Yang, 1996), to evaluate organizational productivity. Thus, we used labor productivity (sales per employee) to measure organizational productivity and re-ran the analysis. Tables 7 to 10 present the results. Models 5 to 10 used the lagged value dependent variables to investigate the effect that decision making structure has on the relationship between IT infrastructure and organizational productivity. In addition, model 11 used labor productivity as an alternative measure of organizational productivity.

Similarly, models 12 to 17 used the lagged value dependent variables to test the effect that senior management involvement has on the relationship between IT infrastructure and organizational productivity. Model 18 used labor productivity as an alternative measure of organizational productivity. Furthermore, Models 19 to 24 used the lagged value dependent variables to investigate the effects of decision making structure on the relationship between IT labor and organizational productivity. Model 25 used labor productivity as an alternative measure of organizational productivity.

Finally, models 26 to 31 used the lagged value dependent variables to investigate the effect that senior management involvement has on the relationship between IT labor and organizational productivity. Model 32 used labor productivity as an alternative measure of organizational productivity.

We also found similar results in our robustness check for all 28 models. Specifically, even though we found a significant change among the direct effects of the moderating variables, the sign and significance of the coefficient for the moderating effect did not change. In other words, the interaction between IT infrastructure intensity (similarly, IT labor intensity) and IT governance's decision making structure was positive and significant in all regression models. On the other hand, the interaction between senior management involvement and both types of IT investment measures was not significant in all regression models. Therefore, we conclude that our results are robust under a wide range of model specifications.

Table 7. Results of Robustness Checks: Interaction between IT Infrastructure Intensity and DMS¹

Variable / hypothesis	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
Industry	...	...	...	...	...	...	...
Market cap	0.798***	0.820***	0.817***	0.808***	0.803***	0.791***	0.093*
IT infrastructure intensity	-0.181***	-0.208***	-0.185***	-0.154***	-0.178***	-0.153***	-0.159**
DMS	-0.057	-0.040	-0.048	-0.047	-0.054	-0.069	-0.101*
IT inf. x DMS	0.093**	0.100**	0.094**	0.104**	0.117**	0.106**	0.127**
Adjusted R ²	0.692	0.736	0.702	0.667	0.661	0.678	0.433
F-model	23.075***	27.239***	22.461***	19.731***	19.316***	21.080***	8.229***
Max VIF	1.38	1.42	1.37	1.39	1.41	1.38	1.39

¹ β-estimates are standardized regression coefficients.
 * p < 0.10, ** p < 0.05, *** p < 0.01.
 We omit industry variables to save space.

Table 8. Results of Robustness Checks: Interaction between IT infrastructure intensity and SMI¹

Variable / hypothesis	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Industry	...	...	...	...	...	...	...
Market cap	0.789***	0.820***	0.817***	0.808***	0.803***	0.791***	0.093*
IT infrastructure intensity	-0.178***	-0.205***	-0.182***	-0.152***	-0.176***	-0.154***	-0.158**
SMI	-0.053	-0.050	-0.066*	-0.049	-0.036	-0.030	-0.023
IT Inf. x SMI	-0.013	-0.010	-0.014	-0.025	-0.002	0.000	0.009
Adjusted R ²	0.683	0.727	0.695	0.658	0.646	0.663	0.408
F-model	22.160***	26.059***	21.821***	19.938***	18.138***	19.757***	7.527***
Max VIF	1.39	1.42	1.38	1.40	1.42	1.39	1.38

¹ β-estimates are standardized regression coefficients.
 * p < 0.10, ** p < 0.05, *** p < 0.01.
 We omit industry variables to save space.

Table 9. Results of Robustness Checks: Interaction between IT Labor Intensity and DMS¹

Variable / hypothesis	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25
Industry	...	...	...	...	...	...	...
Market cap	0.789***	0.820***	0.817***	0.808***	0.803***	0.791***	0.092*
IT labor intensity	-0.161***	-0.199***	-0.165***	-0.151***	-0.158***	-0.133***	-0.129**
DMS	-0.055	-0.038	-0.046	-0.045	-0.054	-0.069	-0.96*
IT labor x DMS	0.050**	0.080**	0.080**	0.088**	0.094**	0.084**	0.106**
Adjusted R ²	0.685	0.730	0.694	0.664	0.652	0.669	0.422
F-model	22.335***	26.492***	21.709***	19.441***	18.562***	20.274***	7.877***
Max VIF	1.36	1.39	1.35	1.38	1.39	1.37	1.38

¹ β-estimates are standardized regression coefficients.
 * p < 0.10, ** p < 0.05, *** p < 0.01.
 We omit industry variables to save space.

Table 10. Results of Robustness Checks: Interaction between IT Labor Intensity and SMI¹

Variable / hypothesis	Model 26	Model 27	Model 28	Model 29	Model 30	Model 31	Model 32
Industry	...	...	...	...	...	...	...
Market cap	0.789***	0.820***	0.817***	0.808***	0.803***	0.791***	0.092*
IT labor intensity	-0.161***	-0.198***	-0.164***	-0.149***	-0.158***	-0.134***	-0.130**
SMI	-0.056	-0.054	-0.069*	-0.050	-0.039	-0.032	-0.026
IT Inf. x SMI	-0.007	0.008	-0.003	-0.018	0.007	0.010	0.007
Adjusted R ²	0.678	0.725	0.690	0.657	0.642	0.659	0.403
F-model	21.725***	25.876***	21.352***	18.883***	17.802***	19.387***	7.351***
Max VIF	1.36	1.40	1.36	1.39	1.40	1.37	1.37

¹ β -estimates are standardized regression coefficients.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
We omit industry variables to save space.

5 Discussion

In this study, we examine the mechanism that organizations use to generate business value from their IT investment. We focus on the role that IT governance has on the relationship between IT investment and organizational productivity. Guided with a research framework that integrates strategic choice theory and contingency theory, we use organization-level data to empirically analyze the moderating effect that IT governance practice has on the business value of IT. Our results show that effectiveness of the decision making structure in IT governance positively influences business value of IT. However, senior management involvement had an insignificant effect.

5.1 Research Implications

With this study, we make three contributions to the literature. First, we develop a novel framework that combines strategic choice and contingency theories. Even though prior studies have used each theory to study the business value of IT, no study to date has combined them to examine the impact that IT governance has on the relationship between IT investment and organizational productivity. The framework considers the role that decision making structure and senior management involvement have in this relationship. The average adjusted R² for the overall models was 0.72, which indicates that the models explained approximately 72 percent of the variation in this relationship. Therefore, this framework improves existing knowledge about IT investment and organizational performance relationship due to its explanatory power.

Second, our findings indicate that effective decision making structure mechanisms have a positive and significant effect on the IT infrastructure-organizational productivity relationship and the IT labor-organizational productivity relationship. Even though studies in the literature have recognized IT governance's value, few have considered the role that IT governance has in the IT investment and organizational productivity relationship. Specifically, no up-to-date study has investigated the moderating role that decision making structure has on the relationship between IT investment and organizational performance. This study contributes to the literature by emphasizing the importance of decision making structure in IT governance.

Third, our findings indicate that senior management involvement in IT governance has no significant impact on the relationship between IT infrastructure and organizational productivity or the relationship between IT labor and organizational productivity. As for why, one possible reason lies in population ecology theory, which focuses on the effects of the environment on organizational structure (St-Jean, LeBel, & Audet, 2010; Welbourne & Andrews, 1996). This theory considers the population of companies as the unit of analysis instead of individual organizations (Young, 1988). The theory assumes that organizational changes take place at the population level due to environmental factors and not at the individual organization level. In other words, organizations could determine their structure by mimicking the population (such as other companies) in the environment (DiMaggio & Powell, 1983). Thus, managers' actions would have a limited impact on organizational performance (Hannan & Freeman, 1977). Therefore, this study contributes to the literature by highlighting this ecological view of organizations.

Further investigation would help to explain the impact that senior management involvement has on the IT investment and organizational productivity relationship.

5.2 Managerial Implications

Our findings have important managerial implications as well. Our analyses show that, while decision making structure has a significant effect on the IT investment-organizational productivity relationship, senior management involvement has no significant impact. Therefore, organizations must institute effective IT governance mechanisms to maximally create business value from their IT investment. Particularly, decision making structure mechanisms significantly increase the benefit from every dollar spent on IT infrastructure and on IT labor. In contrast, senior management involvement in IT governance has an insignificant impact on the IT investment-productivity relationship. These results suggest that putting robust IT governance mechanisms in place can eliminate the need for senior management involvement. Therefore, our results indirectly suggest that senior managers should allocate resources for their organizations to develop IT governance mechanisms rather than themselves becoming involved with every IT decision.

5.3 Limitations and Future Research

Despite our encouraging findings, we note several limitations with our study. First, we used self-reported data. Therefore, we cannot rule out the possibility of bias. However, the relatively large sample size helps to mitigate this issue (Bhansali & Zhu, 2008; Brynjolfsson & Hitt, 1996). Second, the data's cross-sectional structure limits our ability to generalize the results. The importance of business value of IT and the evolving technology and business environment call for continued investigation.

One could extend our study in at least three directions. First, one could use alternative measures to evaluate organizational performance. Measures such as profitability and market value would generate additional insights. Second, one could test IT governance mechanisms separately to capture more detailed information about its impact on the relationship between IT investment and organizational performance. Finally, in addition to senior management involvement, one could use board-monitoring mechanisms (such as chief executive officer duality and outsider board member ratio) to test the effect that senior management involvement has on the relationship between IT investment and organizational productivity.

6 Conclusion

IT investment's role in organizational performance has been, and remains, an important discussion point in the literature. We draw on strategic choice theory and contingency theory to formulate a theoretical framework to investigate the impact that IT governance has on the relationship between IT investment and organizational performance. We used survey data collected from 230 publicly traded organizations to test the proposed theoretical model.

In summary, we found the importance of decision making structure in helping organizations to maximize the business value of their IT investment. Advances in theory and continued empirical investigation will provide much needed guidance to help organizations effectively use IT to accomplish their objectives.

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