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How Information Technology Governance Influences Organizational Agility: The Role of Market Turbulence

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ABSTRACT

We used a novel approach by extending the resource-based view with the dynamic capabilities view to capture the relationship between IT governance and organizational agility. Results from our survey of senior managers suggest that IT and innovation capabilities fully mediate IT governance on organizational agility. They show the strong impact of both IT governance and IT capability on organizational agility with high market turbulence, whereas innovation capability highly impacts organizational agility with low market turbulence.

KEYWORDS

IT governance; IT capability; innovation capability; organizational agility; market turbulence; IT business value

Introduction

Information technology (IT) is widely regarded as a critical foundation for organizational success, influencing how firms create and capture the value and outperform competitors (Chen et al., 2014; Grover et al., 2018; Lu & Ramamurthy, 2011). IT governance is crucial in maximizing the business value of IT, as it influences the management of IT capability and further provides a stable and safe platform for different innovative approaches. As a result, it helps sustain the competitive advantage by promoting organizational agility. Previous studies on the business value of IT have examined the determinants of IT governance success (Buchwald et al., 2014) and the role of IT governance in supporting organizational performance (Chau et al., 2020; Zhang et al., 2016). Nevertheless, the role of IT governance in a dynamic environment and its impact on organizational agility is under-studied and limited research is available to investigate that role.

Developing organizational agility through IT and innovation is a long-term process and a difficult task for any organization (Lowry & Wilson, 2016; Teece et al., 2016). Effective IT governance provides a framework that enables organizations to leverage their IT capability and manage their innovative practices. The IT governance framework ensures the strategic alignment of the objectives of IT with the business

objectives of the organization (Gregory et al., 2018). That would support and improve organizational agility (Gregory et al., 2018; Wu et al., 2015) and their performance (Chau et al., 2020).

Researchers regard organizational agility as a manifestation of higher-order organizational capabilities, thus enabling the firm to efficiently and effectively manage its resources to create value in response to various internal and external conditions (Overby et al., 2006; Teece et al., 2016). An organization's dynamic capabilities determine how it integrates, builds, and reconfigures internal and external competencies to address changing business environments (Teece, 2018). Both RBV and DCV are two views that allow us to understand how firms can achieve organizational agility using resources and capabilities. However, RBV doesn't explain the response to market turbulence (Eisenhardt & Martin, 2000). Market turbulence can precipitate rapid and unpredictable changes in customers' needs and preferences (Jaworski & Kohli, 1993). These changes can be continuously dynamic and pose a challenging threat to the competitive state of the organization. With unpredictable market changes, the dynamic capabilities can enable firms to build and reconfigure their resource base; thus, helping them to manage emerging opportunities or impending threats. The dynamic capabilities emphasize how firms can use their internal resources and external capabilities to sustain their agility in a dynamically unpredictable environment. The

DCV extends the RBV by explaining how dynamic capabilities can govern when faced with turbulent market conditions (Teece et al., 2016).

There is scarce research investigating the impact of IT governance on organizational agility. There are even fewer studies that examine this relationship under the effect of market turbulence. We bridge this gap by answering two research questions:

(i) How can IT governance influence organizational agility, and

(ii) How can market turbulence modify this relationship?

We surveyed senior managers from different industries in 132 firms to study the influence of IT governance mechanisms on organizational agility and investigate the mediating role of IT capability and innovation capability on this relationship. We also examined the moderating role of market turbulence when organizational agility is much needed. We tested the proposed conceptual model with a sample of senior managers in medium-to-large firms, and the empirical analysis supports our theory. Our study shows that IT capability and innovation capability fully mediate the effect of IT governance on organizational agility. Our results also show the strong impact of IT governance and IT capability on organizational agility when associated with high market turbulence. However, the effect of innovation capability on organizational agility is high when market turbulence is low. Looking through the RBV lens, our model explains how IT governance, innovation capability, and IT capabilities are potential sources for organizational agility. We extended RBV with DCV to explain how IT governance can impact IT capability, innovation capability, and organizational agility. That also explains how changing market conditions can influence that impact.

We organize the rest of the article as follows. First, we briefly review the conceptual background to show how IT governance plays a critical role in managing IT capability, innovation capability, and organizational agility. We also examine the role of market turbulence on organizational agility. Second, we propose the research model and the relationships between IT governance, IT capability, innovation capability, and organizational agility under the moderating effect of turbulent market conditions. Third, we outline the research design and how the data were collected and analyzed. Fourth, we discuss the analysis of the results and the conclusion reached. Finally, we summarize the theoretical contribution and the practical implications of the model and point out the limitations and areas for future research.

Background

We review the research that has an impact on our study. We review the five domains of our research: organizational agility, IT governance, IT capability, innovation capability, and market turbulence. Then, we examine how they relate to each other and how they provide the rationale for the model of this study.

IT governance

IT governance deals with the strategic direction of IT at the board level with the necessary oversight to align IT goals with business objectives to realize IT business value and minimize IT risks. According to the IT Governance Institute (ITGI), IT governance is the management control exercised by the board and senior management to achieve the business objectives under normal or turbulent environmental conditions (Guldentops et al., 2003). Strategically integrating plans of both IT and corporate is a critical factor in achieving business objectives (Henderson & Venkatraman, 1999). IT governance provides management control for IT capability, including outsourced ones (Lioliou et al., 2014); although these controls still have limitations in current practice (Aubert & Rivard, 2020). On the other hand, poor or absent IT governance often manifests itself through poor acquisition, development, and utilization of IT and ultimately through poor IT capability and IT performance. That is usually detected by inflated budgets for projects, unjustifiably increasing operating costs, and taking unnecessary risks with unplanned responses (Ali & Green, 2012). Organizations with more effective IT governance had higher overall profits, and hence effective IT governance is considered the most significant predictor of IT business value (Weill & Ross, 2004).

The IT governance mechanisms provide IT strategic direction to ensure realizing organizational goals with appropriate management by maintaining a balance between IT value and IT risks. Management implements them through structures, processes, and communication mechanisms that enable the achievement of business objectives under normal or turbulent environmental conditions (Van Grembergen et al., 2004).

The IT governance structure defines clear roles, responsibilities, and accountability for IT decisions, e.g., IT Strategy Committee. The IT leadership at the top of the IT organizational structure, such as the Chief Information Officer (CIO) and Chief Digital Officer (CDO), must attend board meetings and is responsible for defining the vision and mission for the IT role in the organization and communicating it to all relevant parties. However, there is no best structure, and each

organization typically plans its own that is appropriate for its business, industry, size, and organizational culture. The IT governance processes monitor IT operating practices based on policies and procedures approved by the board and senior management. Management typically uses tools and techniques such as COBIT, ITIL, etc., to achieve that. The processes include many different tasks, such as IT balanced scorecard analysis and cost/benefit/risk analysis. The IT governance communication mechanism addresses advocacy and communication of IT governance principles, policies, and procedures, such as a shared understanding of business and IT objectives, job rotation, and active involvement of key stakeholders (Van Oosterhout et al., 2006). These mechanisms are considered unique to organizations, which explains their root in RBV. Each organization needs to select IT practices that are appropriate and relevant to its business objectives and industry standards and have them reviewed and audited for compliance regularly.

IT capability

IT capability is the organization's ability to acquire and implement IT-dependent resources needed to achieve its business objectives. Based on the resource-based view (RBV), the IT capability, combined with the organization's resources and capabilities, can provide the needed competitive advantage (Bharadwaj, 2000). However, some researchers argue that IT-enabled business processes are fundamental components in gaining competitive advantage (Doherty & Terry, 2009; Gu & Jung, 2013; Ray et al., 2005). Thus, the critical IT resources and capabilities are the ones that serve business processes considered vital, and they deserve the most attention to gain the desired competitive advantage (Trkman, 2010). IT governance provides better management and utilization of IT resources and capabilities, especially those that support the critical business processes, making them flexible and ready for any needed changes in unpredictable conditions.

IT capabilities are described as lower-order capabilities that enable the development of higher-order capabilities such as organizational agility (Chakravarty et al., 2013; Lu & Ramamurthy., 2011; Roberts & Grover, 2012). Taking full advantage of their existing IT capability, firms can enhance their competitive advantage and performance (Bhatt & Grover, 2005; Chen et al., 2014; Santhanam & Hartono, 2003). IT capability has proven to be very useful in various aspects of organizational practice. Researchers have found that IT capability enables product innovation (C. D. Chen & Chen, 2015) and service innovation (J. S. Chen & Tsou,

2012) with improved organizational performance (Braojos et al., 2019). IT capability also enables digital transformation (Nwankpa & Roumani, 2016) and influences the development of digital platforms over time (Tan et al., 2015). IT capability can improve organizational performance directly or indirectly through mediators such as organizational agility (Sambamurthy et al., 2003; Lu & Ramamurthy, 2011; Felipe et al., 2020). In addition, the IT capability enables business experimentation and provides needed flexibility; thus, it facilitates both the exploration and exploitation of different market opportunities that allow organizations to survive in turbulent environmental conditions (Benitez et al., 2018).

Innovation capability

An organization's innovation capability refers to its ability to create and adopt new ideas defying its traditional way of working. That means its ability to change and try uncharted and untried approaches, such as new management practices, new marketing concepts, and new business strategies (Camisón & Villar-López, 2014; Menguc & Auh, 2006). Based on changing market conditions, IT governance can support exploring and developing innovations or exploiting the current system to increase organizational efficiency (Andersen et al., 2017). Organizations with higher innovation capabilities can be reactive or proactive depending on the turbulent market encountered. The same organization may respond differently depending on their IT capability at the time. They may take a radically innovative approach or prefer to be incremental. It depends on the nature of the product or service changes required. Some researchers claim that innovativeness is a habitual capability that can directly create value through new products and services (Camisón & Villar-López, 2014). RBV provides the theoretical framework that facilitates the analysis of innovation and its link to performance (Mol & Birkinshaw, 2009). However, other researchers argue that an organization's innovation capability is a significant element of dynamic capabilities (Menguc & Auh, 2006) essential to managing uncertainty generated by market turbulence (Teece et al., 2016).

Organizational agility

Data-intensive environments are subject to rapid and uncertain changes that are foundational for an innovation-driven economy (El Sawy et al., 2010). A management concept essential to respond to data-intensive environments is organizational agility (Singh et al., 2013). Researchers regard organizational agility as a manifestation of higher-order organizational

capabilities, thus enabling the firm to efficiently and effectively manage its resources to create value in response to various internal and external conditions (Overby et al., 2006; Teece et al., 2016). It is a systematic variation in organizational outputs, structures, and processes to gain a competitive advantage (Tallon & Pinsonneault, 2011; Van Oosterhout et al., 2006).

Previous research on the concept of agility emphasizes the importance of managing uncertainty (Teece et al., 2016) while making the necessary organizational changes (Overby et al., 2006). However, there is a paradox in the relationship between IT and organizational agility, as previous research identified the role of IT as both an enabler (Sambamurthy et al., 2003) and a constraint (Overby et al., 2006) in achieving organizational agility. Because of the changing nature of the relationship between IT and organizational agility, making organizations agile can be challenging and costly. Researchers attribute this to the need for having different business models, organizational structures, IT systems, and investments to support the relationship between IT and organizational agility. Therefore, researchers argue that IT plays a critical role in supporting organizational agility, which is context-sensitive (Teece et al., 2016).

Market turbulence

A significant type of environmental change is market turbulence (Eisenhardt & Martin, 2000). Market turbulence can lead to rapid and severe changes in customer needs and preferences (Jaworski & Kohli, 1993) and hence pose a high risk to current business processes and the technology used. During market turbulence, organizations are exposed to changes in their business models and must modify their business processes, even core processes, before their competitors (Y. Xue et al., 2008). That may require them to invest more in IT to improve operational efficiency to maintain their competitive advantage. In addition, more efficient use of resources, including IT, through sharing and better coordination among different business units would support the business more (L. Xue et al., 2011).

In data-intensive environments, the need for quick relevant information is critical, and organizations that have superior technical capabilities would have the IT systems and applications ready to support such requirements (El Sawy et al., 2010). As organizations may need to modify their business processes or even change their business models, IT capability would provide the means to achieve that, while IT governance would assure a smooth transformation from one state to another.

Consequently, organizations with superior technical capabilities would earn more profit in such an environment (K. B. Lee & Wong, 2011). They would respond quickly and effectively to these unpredictable challenges compared to other organizations.

Conceptual model and hypotheses

Based on the IT-enabled dynamic capabilities (Mikalef et al., 2020) and the resource-action-performance framework (Ketchen et al., 2007), we conceptualize our model (Figure 1). We propose that IT governance and the two capabilities (innovation capability and IT capability) act as resources to enable the organization's strategic pursuit of agility. Innovation capability and IT capability mediate the relationship between IT governance and organizational agility, and market turbulence moderates the governance-agility and capabilities-agility relationships. IT governance complements traditional dynamic capabilities (Khalil & Belitski, 2020; Rai et al., 2006; Sarker et al., 2012). As dynamic capabilities facilitate enhanced IT-business alignment, some researchers argue that IT governance is, in essence, one of the dynamic capabilities since it can provide organizations with the ability to sense and respond quickly and effectively (H eroux & Fortin, 2018).

IT governance ensures the strategic alignment of business and IT objectives which enhances the innovation objectives of the company. The board and senior management may make different choices when leveraging innovation for organizational agility (Asensio-L opez et al., 2019). Aligned with the business objectives, IT governance can support exploring and exploiting innovative practices to increase organizational efficiency (Andersen et al., 2017). Using new technologies and practices innovatively and developing new products and services will impact the desired organizational agility (Ashrafi et al., 2019). We argue that IT governance can exert a powerful impact on organizational agility through its influence on the innovative practice of the firm. IT governance mechanisms provide the management with the needed controls to have a dynamic IT infrastructure that facilitates the desired innovation practice (Tiwana & Konsynski, 2010).

Because IT governance mechanisms ensure a strategic alignment between IT objectives and business objectives, that would result in having the desired IT capability that serves the business objectives. IT governance provides better management and utilization of IT capability, making IT capability flexible and ready for any needed changes in unpredictable conditions. Thus, firms possessing more effective IT governance are likely to have more effective and efficient IT capability

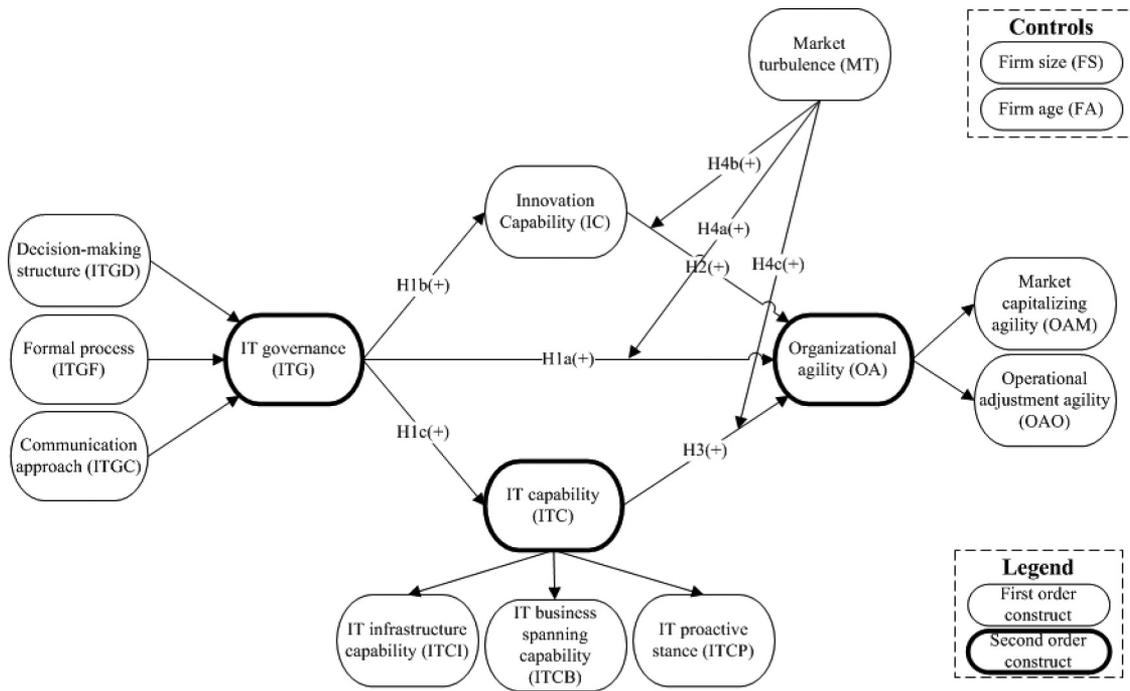


Figure 1. Conceptual model.

(Peterson, 2004). Firms that hold a higher IT capability usually exceed their competitors (Bharadwaj, 2000), as they would be in a better state to sense and respond to changing environmental conditions (DeGroot & Marx, 2013). They can do so by monitoring the environment, and making quick and effective decisions, thereby reconfiguring their internal processes and achieving the desired readiness state (Lu & Ramamurthy, 2011). We argue that IT governance can exert a powerful impact on organizational agility mediated by its influence on IT capability.

The role of IT governance

IT governance mechanisms impose the necessary control to align IT objectives with business objectives. One of these mechanisms is the IT governance structure that defines clear roles, responsibilities, and accountability for IT decisions. This high integration of business and IT decisions enforces implementing the needed IT capability required to achieve and maintain the desired state of organizational agility (Peterson et al., 2002). That ensures identifying and selecting IT business cases based on business prioritization and evaluation of IT decisions. Another mechanism is the IT governance processes that have a crucial role in monitoring IT operating practices, including those responsible for developing and maintaining organizational agility based on policies and procedures approved by the

board and senior management. Another mechanism for IT governance is the communication mechanisms concerned with a shared understanding of business/IT objectives, including organization agility. The state of the agile organization will depend on the joined collaboration of senior management, including the IT leadership, to review main requirements and proposals from different business units, hence, rendering the decision-making process more agile (Aghina et al., 2015). Furthermore, IT governance enhances the effective leveraging of IT capability that improves organizational agility (Zhen et al., 2021). We posit that:

H1a: IT governance is positively associated with organizational agility.

The relationship between IT governance and innovation has its roots in the impact of the board of directors or senior management on the innovation process (Asensio-López et al., 2019). Some senior managers may prefer to take a proactive and exploring approach to stay ahead of the competition. Other managers prefer a risk-averse approach and take a reactive and exploiting approach to maintain their competitive status (Ashurst et al., 2012). However, in either case, it is challenging to achieve strategic innovation without the needed service infrastructure and the realization of the business value of IT in supporting or driving the innovation process (Peterson, 2004). IT governance ensures the strategic

alignment of business and IT objectives which are considered the most significant success factor in many studies (Alreemy et al., 2016). That enhances the innovation objectives of the company, whether in current practice or the upcoming plans. It comes with the advantage that both exploring and exploiting the core organizational resources would stimulate the innovation process (Tallon & Pinsonneault, 2011). Based on the business objectives, IT governance can support exploring and developing innovations (exploration) or exploiting the current system to increase organizational efficiency (exploitation) (Andersen et al., 2017). Notably, IT governance mechanisms increase the business value of IT both in-house and in an outsourced context. The management controls imposed through IT governance ensure that the modular IT infrastructure will facilitate the desired innovation practice (Tiwana & Konsynski, 2010). It also provides a reasonable assurance for business continuity and in-effect innovation continuity when threatened by market changes. We posit that:

H1b: IT governance is positively associated with innovation capability.

One of IT governance's main concerns is having efficient management of the firm's IT capability (J. Lee & Lee, 2008). IT governance provides the ability to choose among different options of IT capability usage and hence, to have monitoring controls that allow a smooth transformation from one IT capability state to another. IT governance provides the ability to do the right thing while doing things right. That is the desired behavior under normal conditions and more in a turbulent environment. IT governance and dynamic capabilities allow the firm to become more flexible and agile when using digital technologies, whether adapting, reconfiguring, or implementing new technologies, systems, and applications. Hence, IT governance provides better management and utilization of IT capability, making it flexible and ready for any needed changes in unpredictable conditions. Firms possessing more effective IT governance are likely to have more effective and efficient IT capability (Peterson, 2004). As IT governance complements traditional dynamic capabilities (Khalil & Belitski, 2020; Rai et al., 2006; Sarker et al., 2012), it would enable the firm to mitigate the risks in the digital environment (Helfat & Peteraf, 2003). As dynamic capabilities facilitate enhanced IT-business alignment, some researchers argue that IT governance is, in essence, one of the dynamic capabilities since it can provide organizations with the ability to sense and respond quickly and effectively (Héroux & Fortin, 2018).

IT governance is not alone in having a dynamic aspect, as mentioned earlier, but researchers also investigated IT capability for that same aspect. Some scholars studied the potential dynamic capabilities of IT using different terms. For example, they used dynamic IT capabilities (Li & Chan, 2019), IT-enabled dynamic capabilities (Mikalef & Pateli, 2017), and IT application orchestration capability (Queiroz et al., 2018). They share common attributes, e.g., having the ability to sense and respond quickly and effectively to environmental changes. We propose that IT governance has a strong influence on IT capability. It provides the framework that allows the needed control for proper development, acquisition, maintenance, and update for IT capability. We assert that:

H1c: IT governance is positively associated with IT capability.

The role of innovation capability

The board and senior management may make different choices when leveraging innovation for organizational agility (Asensio-López et al., 2019). Some may lean toward a proactive and exploratory approach that enables early detection and rapid response well ahead of the competition. Others are more cautious about developing new products or services quickly because of their risk aversion. In either case, using new technologies and practices innovatively and developing new products and services will impact the desired organizational agility (Ashrafi et al., 2019). To introduce innovation, many companies prefer to create a separate unit that can be linked to the core business as new initiatives are explored or leveraged.

For example, one of the leading manufacturers in Powder Metallurgy, GKN, created a separate unit outside its existing organizational structure. The company wanted to stay ahead of the competition using 3D printing. The company realized its business goal by incorporating the new separate entity into a start-up company called 3YOURMIND (3 YD), which has the required expertise in 3D printing (Wildhirt et al., 2019). In another example, KAESER, one of the leading manufacturers of compressed air systems, has developed a new service-based operator model. In this model, customers do not sell air compressors but pay a monthly fee only for the compressed air they use. KAESER also developed a new business unit to implement this innovative practice (Bock et al., 2019). Both companies used new technologies innovatively to achieve their business goals. They also created new business units, allocated

resources, and successfully accommodated the innovative practice with new technologies in response to anticipated market changes. We argue that:

H2: Innovation capability is positively associated with organizational agility.

The role of IT capability

Many studies investigated the direct effects of IT capability on organizational agility, and recent research is trying to understand the mechanisms of these effects, including what factors influence IT capability and what can moderate it (Chen et al., 2014; Lu & Ramamurthy, 2011). Firms that hold a higher IT capability usually exceed their competitors (Bharadwaj, 2000), as they would be in a better state to sense and respond to changing environmental conditions (DeGroot & Marx, 2013). They can do so by monitoring the environment, and making quick and effective decisions, thereby reconfiguring their internal processes and achieving the desired readiness state (Lu & Ramamurthy, 2011). Commonly argued that when firms take the full benefits of their IT capability, they have a better opportunity to become agile and sustain their competitive advantage. IT capability practice, through complementing IT, provides value to firms (Aral & Weill, 2007; Melville et al., 2004). Yet, some researchers argue that IT capability may not offer that needed expectation widely believed (Chae et al., 2018, 2014). Some even argue that IT capability may act as a barrier to becoming agile and hinder the response desired by the firm in facing different environmental conditions, especially in SMEs (Neirotti & Raguseo, 2017). However, we argue that effective IT governance mechanisms shift the balance toward a positive influence of IT capability on organizational agility. We posit that:

H3: IT capability is positively associated with organizational agility.

The role of market turbulence

Market turbulence poses challenges and various pressures that affect the governance of decision-making processes by demanding new resources and capabilities from the organization (Y. Xue et al., 2008). The response may require improving operational efficiency with more IT investment (Philip, 2007). Such pressure would mandate the company to rely on its specialized department,

such as IT, which controls the resources and capabilities that support critical business processes. Acting under different conditions, such as complying with market regulations imposed by the government or emulating successful competitors, requires early recognition and anticipation of market changes. That also requires an early and rapid response, i.e., an appropriate transformation process that aligns IT objectives with business goals. Although these are different types of pressures, there is a similar logic by which they impact organizational governance and, in turn, IT governance. There is a delicate balance in the decision-making process between the IT unit and the business unit that can shift in either direction (Queiroz et al., 2018). We assert that:

H4a: Market turbulence positively moderates the relationship between IT governance and organizational agility.

Innovation capability can counter the threat of competitive innovation, including innovation opportunities that may emerge (Helfat & Raubitschek, 2018). It enables the company to be alert and to identify market turbulence at an early stage. Therefore, it is a significant factor for long-term success, especially in constantly changing markets (Jiménez-Jiménez & Sanz-Valle, 2011). Early recognition of market changes and rapid innovative responses enable the company not only to deal with unforeseen threats but, more importantly, to take advantage of opportunities as they arise. Creative responses range from changing business processes to creating new business models. In addition, innovative approaches to providing new products and services in response to customer preferences are becoming increasingly realistic. Those unable to do so will quickly lose the market to their competitors (Zhou et al., 2019). We posit that:

H4b: Market turbulence positively moderates the relationship between innovation capability and organizational agility.

Companies with higher IT capability tend to outperform their competitors (Bharadwaj, 2000) because they can identify and respond to market changes better than competitors. They can transform their internal processes and even change their business model. KAESER, a global manufacturer of compressed air systems and services, has developed a new business model that requires customers to pay a monthly base fee only for the compressed air they use rather than selling air compressors (Bock et al., 2019). Transforming a core business process or changing the business model in response to market

turbulence requires that companies have appropriately skilled personnel, critical resources, and the ability of current IT systems to adapt within acceptable costs (Lu & Ramamurthy, 2011; Ravichandran, 2018). We assert that:

H4c: Market turbulence positively moderates the relationship between IT capability and organizational agility.

Research design

In the following section, we present our data collection strategy by defining the target population, the level of analysis, nature of the survey, sample size estimation, the survey instruments, and how we managed the common method bias (CMB).

Instrument development

We adapted measurement scales from previous studies. First, we reviewed the literature to have minimal overlap between constructs. Table 1 provides a summary of the scales used and the supporting literature. We measured the constructs with multiple indicators on a seven-point scale (1 = strongly disagree, 7 = strongly agree) (except for control variables). We conducted a pilot study before the online survey, and the number of participants was 45. The pilot results showed evidence of the validity and reliability of the instruments.

IT governance is conceptualized as a latent second-order formative-reflective type (Ringle et al., 2012) with three first-order dimensions: decision structure, formal process, and communication approach (Wu et al., 2015). They measure three mechanisms implemented by organizations, and the measurement items assess the degree of well-balanced governance mechanisms.

We conceptualized IT capability as a second-order construct of reflective-reflective type (Ringle et al., 2012). It has three first-order dimensions: IT infrastructure capability, IT business spanning capability, and IT proactive stance (Lu & Ramamurthy, 2011). We measured the construct of organizational innovation capability by five reflective items (Hurley & Hult, 1998; Menguc & Auh, 2006). We adapted the measures for market turbulence from a previous study (Jaworski & Kohli, 1993).

Organizational agility is a high-order construct having two sub-constructs: market capitalizing agility and operational adjustment agility (Hair et al., 2016). Each construct is a reflective latent variable having three items. We measured the market capitalizing

agility with three reflective indicators that indicate the firm's ability to respond quickly and capitalize on market changes. That is achieved by continuously monitoring and quickly improving products/services to fulfill customers' changing preferences and needs. We measured the operational adjustment agility with three reflective indicators that indicate the firm's ability to physically and quickly respond to market changes relying on its internal business processes. That is critical to support innovative practices meeting market changes.

Data collection

The target organizations in this study were firms from different industries in Brazil. We collected data through an online survey of senior executives in medium to large firms (private and public) that are not industry-specific, i.e., mixed-industry. The unit of analysis is the firm. We received 132 valid responses, which exceeded the recommended requirements. The sample size should be equal to, or more than ten times the highest number of formative indicators used to measure a single construct (Barclay et al., 1995) as cited in (Hair et al., 2016, p. 108). We controlled for two firm characteristics: age and size. The measure for firm size is the firm-wide number of full-time employees and the firm's age as years the company had been in business. The size may exert more significant effects on IT governance and, in addition, the ability to compete under different environmental conditions. Larger firms may have more experience and effectiveness in implementing IT governance frameworks (Devos et al., 2012). That is usually related to the maturity of corporate governance and the board of directors. In the case of market turbulence, larger firms often have more resources than smaller firms. However, none of the controls showed a significant influence on any of the constructs in our research model.

Common method bias (CMB) is a measurement error that results from self-reporting surveys. It leads to lower reliability and validity of the constructs used in the study and the proposed relationships in the research model. However, we tried to minimize such bias ex-ante and ex-post. On the ex-ante, we assured the respondents of both anonymity and confidentiality of their responses (Rogelberg & Stanton, 2007). We also designed the survey in a clear format avoiding ambiguous terms or complicated questions. We selected the measures of our study to be independent of each other and their expected outcomes. We also changed the design of our questionnaire using the scale reordering procedure (i.e., our dependent

Table 1. Constructs and measurement items.

Construct	Items	Authors
IT governance mechanisms		
Decision-making structure (ITGD)	ITGD1: Our company has a Steering Committee at Executive or senior management level responsible for determining IT development prioritization. ITGD2: Our company has a Steering Committee composed of business and IT people focusing on prioritizing and managing IT projects. ITGD3: CIO has a direct reporting line to the CEO and/or COO.	(Wu, Straub, & Liang, 2015) (De Haes & Van Grembergen, 2009) (Weill & Ross, 2004)
Formal process (ITGF)	ITGF1: Our company has established a formal prioritization process for IT investments and projects in which business and IT is involved. ITGF2: Our company has established formal processes to define and update IT strategies. ITGF3: Our company has established formal processes to govern and manage IT projects.	
Communication approach (ITGC)	ITGC1: CIO is a full member of the executive committee. ITGC2: Our company has a committee at level of broad of directors to ensure IT is regular agenda item and reporting issue for the board of directors. ITGC3: The CIO or similar role in our company is able to clearly articulate a vision for IT's role in the company.	
IT capability		
IT infrastructure capability (ITCI)	ITCI1: Data management services & architectures (e.g., databases, data warehousing, data availability, storage, accessibility, sharing etc.) ITCI2: Network communication services (e.g., connectivity, reliability, availability, LAN, WAN, etc.) ITCI3: Application portfolio & services (e.g., ERP, ASP, reusable software modules/components, emerging technologies, etc.) ITCI4: IT facilities' operations/services (e.g., servers, large-scale processors, performance monitors, etc.)	(Lu & Ramamurthy., 2011) (Bharadwaj, Sambamurthy, & Zmud, 1998) (Fichman, 2004) (Mata, Fuerst, & Barney, 1995) (Ross, Beath, & Goodhue, 1996) (Weill, Subramani, & Broadbent, 2002)
IT business spanning capability (ITCB)	ITCB1: Developing a clear vision regarding how IT contributes to business value ITCB2: Integrating business strategic planning and IT planning ITCB3: Enabling functional area and general management's ability to understand value of IT investments ITCB4: Establishing an effective and flexible IT planning process and developing a robust IT plan	
IT proactive stance (ITCP)	ITCP1: We constantly keep current with new information technology innovations ITCP2: We are capable of and continue to experiment with new IT as necessary ITCP3: We have a climate that is supportive of trying out new ways of using IT ITCP4: We constantly seek new ways to enhance the effectiveness of IT use	
Innovation capability (IC)		
	IC1: Technical innovation, based on research results, is readily accepted. IC2: We actively seek innovative ideas. IC3: Innovation is readily accepted in program/project management. *IC4: Employees are penalized for new ideas that do not work. *IC5: Innovation in our company is perceived too risky and is resisted.	(Menguc & Auh, 2006) (Hurley & Hult, 1998)
Organizational agility		
Market capitalizing agility (OAM)	OAM1: We are quick to make and implement appropriate decisions in the face of market/customer-changes. OAM2: We constantly look for ways to reinvent/reengineer our organization to better serve our market place. OAM3: We treat market-related changes and apparent chaos as opportunities to capitalize quickly.	(Lu & Ramamurthy., 2011) (Tsourveloudis, Valavanis, Gracanic, & Matijasevic, 1999)
Operational adjustment agility (OAO)	OAO1: We fulfill demands for rapid-response, special requests of our customers whenever such demands arise; our customers have confidence in our ability. OAO2: We can quickly scale up or scale down our production/service levels to support fluctuations in demand from the market. OAO3: Whenever there is a disruption in supply from our suppliers we can quickly make necessary alternative arrangements and internal adjustments.	
Market turbulence		
Market turbulence (MT)	MT1: In our kind of business, customers' product preferences change quite a bit over time. MT2: Our customers tend to look for new product all the time. MT3: We are witnessing demand for our products and services from customers who never bought them before. MT4: New customers tend to have product-related needs that are different from those of our existing customers. *MT5: We cater to many of the same customers that we used to in the past.	(Jaworski & Kohli, 1993)

Note: * Indicators dropped due to low indicator reliability

variables are after, rather than before, the independent variables) to reduce the effects of consistency artifacts. Ex post, we conducted Harman's one-factor

test (Podsakoff et al., 2003) to determine the extent to which our results are biased. The test suggests that method bias does not account for the study's results.

Data analysis

The technique used to test the research model is the structural equation modeling – partial least squares (PLS-SEM) using SmartPLS version 3.3.2 for data analysis (Ringle et al., 2015). We used PLS-SEM in this study for different reasons. First, as IT governance is a formative construct, PLS-SEM allows modeling latent constructs with formative indicators (Goo et al., 2009; Hair et al., 2016). Second, it is the preferred technique when little theory is available and predictive accuracy is required, as applies to our study (Teo et al., 2003; Garson, 2016, p. 8). Third, when analyzing path coefficients that are different from zero, the PLS technique would prevent restrictive distributional assumptions (Gefen & Straub, 2005). Fourth, as we have a relatively small sample size, PLS-SEM achieves better convergence behavior and high statistical power with a small sample size than covariance-based (CB-SEM) (Hair et al., 2014; Wong, 2013). We analyzed data in our model by conducting a measurement model assessment (reflective and formative constructs) and a structural model assessment (Hair et al., 2016, 2019). Some of our constructs are hierarchical models, e.g., IT governance (reflective-formative type) and IT capability (reflective-reflective type). These hierarchical models have different relationships between the constructs (formative vs. reflective) (Becker et al., 2012). We used the repeated indicators procedure to test them (Hair et al., 2016, p. 277). We assigned all indicators of the lower-order components to the higher-order construct. Then, we measured the higher-order construct using the same indicators of the lower-order ones (Hair et al., 2016; Ringle et al., 2012; Sarstedt et al., 2019).

Measurement model assessment

First, we conducted a reflective measurement model assessment to evaluate the construct reliability, indicator reliability, convergent validity, and discriminant validity. We conducted a measurement model assessment to evaluate the convergent validity, construct reliability, indicator reliability, and discriminant validity of the scales for the reflective constructs. The results of the measurement model assessment are in Table 2 and Table 3. Composite reliability is one of the assessment measures of internal consistency reliability. We tested for construct reliability using composite reliability (CR).

Composite reliability is preferred over Cronbach's alpha as an assessment measure because Cronbach's alpha offers less precision. Composite reliability, on the other hand, provides a better estimate of variance shared by the respected indicators and, hence, this reliability is higher than Cronbach's alpha (Hair et al., 2019). When values are between 0.70 and 0.90, they are considered satisfactory to good. In our study, indicator values are higher than 0.7 for all constructs, as shown in Table 2. That indicates high internal consistency reliability of the reflective latent variables (Hair et al., 2019).

We assessed the convergent validity for the items on each construct using the average variance extracted (AVE). When the values are 0.50 or higher, that is regarded as acceptable because it indicates that the constructs can explain at least 50 percent of the variance of its items. As shown in Table 2, all AVE values are higher than the acceptable threshold of 0.5, confirming convergent validity (Hair et al., 2019). The outer loading of the indicator measures its reliability, and loadings above 0.70 are considered acceptable item reliability (Hair et al., 2019). In Table 3, we see that all loadings are higher than 0.7, thus achieving indicator reliability. However, we discarded IC4, IC5, and MT5 due to a lack of indicator reliability.

Both cross-loading and the Fornell-Larcker criterion provide evidence for the discriminant validity of the constructs. Neither, however, allows us to reliably detect problems with discriminant validity (J. Hair et al., 2017; Hair et al., 2019). We used the Heterotrait-Monotrait ratio (HTMT) to examine the discriminant validity of the constructs (Hair et al., 2019). In Table 4, all HTMT values for the reflective indicators are below the threshold of 0.9, confirming the discriminant validity of the constructs. Then, we conducted a formative measurement model assessment. Because the formative construct IT governance was modeled as a second-order construct (reflective-formative type), we assessed the multicollinearity and statistical significance of the indicator weights. The assessment of multicollinearity was performed using the variance inflation factor (VIF), with values close to 3 and below considered acceptable. Table 5 shows that the VIF ranges from 2.15 (lowest value) to 2.51 (highest value). The values are below the threshold of 3, indicating the absence of multicollinearity between variables (Hair et al., 2019). In terms of significance and sign, the three are satisfactorily significant ($p < 0.01$) and with a positive sign. Since the evaluation of the measurement model was considered satisfactory, we evaluated the structural model.

Table 2. Descriptive statistics, correlation, composite reliability (CR), and average variance extracted (AVE).

	Mean	SD	CR	ITGD	ITGF	ITGC	IC	ITCI	ITCB	ITCP	MT	OAM	OAO
ITGD	4.743	1.687	0.908	0.877									
ITGF	4.502	1.635	0.959	0.734	0.942								
ITGC	4.467	1.682	0.907	0.684	0.678	0.874							
IC	4.419	1.593	0.961	0.531	0.613	0.676	0.944						
ITCI	4.843	1.329	0.944	0.490	0.531	0.540	0.705	0.900					
ITCB	4.646	1.520	0.965	0.506	0.587	0.646	0.747	0.778	0.934				
ITCP	4.783	1.550	0.970	0.401	0.551	0.593	0.799	0.722	0.828	0.944			
MT	4.454	1.410	0.865	0.325	0.338	0.252	0.381	0.422	0.313	0.352	0.788		
OAM	4.097	1.570	0.940	0.359	0.518	0.569	0.724	0.603	0.673	0.733	0.329	0.916	
OAO	4.057	1.480	0.895	0.393	0.505	0.559	0.755	0.529	0.686	0.704	0.200	0.791	0.861

Notes: Values in diagonal (bolt) are the AVE square root; Decision-making structure (ITGD); Formal process (ITGF); Communication approach (ITGC); Innovation Capability (IC); IT infrastructure capability (ITCI); IT business spanning capability (ITCB); IT proactive stance (ITCP); Market turbulence (MT); Market capitalizing agility (OAM); Operational adjustment agility (OAO).

Table 3. Loadings and cross-loadings.

Construct	Item	ITGD	ITGF	ITGC	IC	ITCI	ITCB	ITCP	MT	OAM	OAO
Decision-making structure (ITGD)	ITGD1	0.929	0.705	0.595	0.505	0.503	0.454	0.390	0.297	0.343	0.353
	ITGD2	0.926	0.697	0.630	0.506	0.506	0.527	0.424	0.301	0.360	0.345
	ITGD3	0.765	0.511	0.575	0.376	0.254	0.336	0.222	0.255	0.228	0.339
Formal process (ITGF)	ITGF1	0.684	0.923	0.664	0.588	0.509	0.558	0.527	0.280	0.528	0.537
	ITGF2	0.728	0.950	0.653	0.581	0.511	0.555	0.517	0.380	0.479	0.448
	ITGF3	0.659	0.953	0.598	0.565	0.479	0.546	0.513	0.292	0.456	0.441
Communication approach (ITGC)	ITGC1	0.524	0.534	0.872	0.522	0.395	0.502	0.432	0.242	0.459	0.442
	ITGC2	0.687	0.567	0.907	0.567	0.459	0.528	0.490	0.254	0.480	0.464
	ITGC3	0.574	0.673	0.842	0.678	0.557	0.659	0.626	0.166	0.551	0.557
Innovation Capability (IC)	IC1	0.504	0.617	0.659	0.947	0.674	0.697	0.766	0.386	0.704	0.711
	IC2	0.511	0.584	0.630	0.940	0.675	0.732	0.745	0.316	0.652	0.698
	IC3	0.491	0.536	0.626	0.946	0.648	0.689	0.753	0.374	0.694	0.732
IT infrastructure capability (ITCI)	ITCI1	0.465	0.496	0.511	0.656	0.907	0.744	0.659	0.354	0.519	0.486
	ITCI2	0.509	0.475	0.524	0.597	0.887	0.678	0.578	0.367	0.449	0.420
	ITCI3	0.378	0.474	0.445	0.629	0.892	0.689	0.664	0.402	0.605	0.515
	ITCI4	0.417	0.465	0.467	0.652	0.913	0.687	0.693	0.397	0.592	0.481
IT business spanning capability(ITCB)	ITCB1	0.420	0.498	0.599	0.696	0.772	0.921	0.785	0.291	0.616	0.614
	ITCB2	0.500	0.549	0.617	0.710	0.742	0.952	0.773	0.344	0.654	0.640
	ITCB3	0.450	0.545	0.587	0.713	0.706	0.928	0.771	0.282	0.620	0.660
	ITCB4	0.522	0.603	0.609	0.671	0.682	0.934	0.762	0.250	0.621	0.648
IT proactive stance (ITCP)	ITCP1	0.357	0.496	0.563	0.733	0.749	0.801	0.949	0.288	0.697	0.690
	ITCP2	0.393	0.490	0.545	0.746	0.704	0.793	0.955	0.309	0.671	0.655
	ITCP3	0.370	0.523	0.529	0.755	0.603	0.720	0.918	0.383	0.660	0.632
	ITCP4	0.396	0.573	0.601	0.787	0.662	0.807	0.953	0.356	0.737	0.678
Market turbulence (MT)	MT1	0.282	0.190	0.231	0.247	0.341	0.286	0.244	0.592	0.163	0.087
	MT2	0.282	0.319	0.192	0.312	0.377	0.251	0.259	0.834	0.273	0.134
	MT3	0.212	0.201	0.188	0.326	0.392	0.249	0.293	0.824	0.221	0.144
	MT4	0.271	0.322	0.209	0.318	0.280	0.241	0.315	0.871	0.335	0.225
Market capitalizing agility (OAM)	OAM1	0.270	0.412	0.444	0.593	0.537	0.586	0.606	0.243	0.893	0.676
	OAM2	0.339	0.497	0.535	0.736	0.617	0.658	0.732	0.314	0.938	0.755
	OAM3	0.373	0.512	0.582	0.656	0.501	0.602	0.671	0.345	0.915	0.739
Operational adjustment agility (OAO)	OAO1	0.360	0.458	0.534	0.747	0.582	0.665	0.696	0.279	0.802	0.872
	OAO2	0.357	0.457	0.499	0.598	0.358	0.544	0.557	0.112	0.651	0.886
	OAO3	0.292	0.382	0.400	0.594	0.412	0.553	0.551	0.109	0.567	0.823

Structural model assessment

In our model, we have IT governance, and the two capabilities (innovation capability and IT capability) act as resources that enable the organization’s strategic pursuit of agility. We hypothesized that innovation capability and IT capability mediate the relationship between IT governance and organizational agility, and market turbulence moderates the governance-agility and capabilities-agility relationships. The structural model in Figure 2 shows the

explained variation and path coefficients. The significance levels of the hypothesized relationships were performed by 5,000 bootstrap samples (Hair et al., 2016, p. 170).

Our research model explains 49.4% of the variation in innovation capability (IC). IT governance (ITG) ($\hat{\beta} = 0.697$; $p < 0.01$) is statistically significant to explain innovation capability (IC). Thus, H1b is supported. The model explains 47.2% of the variation in IT capability (ITC). ITG ($\hat{\beta} = 0.680$; $p < 0.01$) is

Table 4. Heterotrait-Monotrait Ratio (HTMT)

	ITGD	ITGF	ITGC	IC	ITCI	ITCB	ITCP	MT	OAM	OAO
ITGD										
ITGF	0.819									
ITGC	0.809	0.760								
IC	0.593	0.654	0.756							
ITCI	0.546	0.571	0.610	0.757						
ITCB	0.560	0.623	0.718	0.791	0.830					
ITCP	0.439	0.582	0.655	0.843	0.765	0.866				
MT	0.405	0.379	0.318	0.441	0.515	0.374	0.405			
OAM	0.405	0.562	0.649	0.784	0.659	0.725	0.786	0.370		
OAO	0.471	0.572	0.663	0.853	0.600	0.771	0.785	0.224	0.906	

Notes: Values in diagonal (bold) are the AVE square root; Decision-making structure (ITGD); Formal process (ITGF); Communication approach (ITGC); Innovation Capability (IC); IT infrastructure capability (ITCI); IT business spanning capability (ITCB); IT proactive stance (ITCP); Market turbulence (MT); Market capitalizing agility (OAM); Operational adjustment agility (OAO).

Table 5. Formative measurement model evaluation

Formative construct (second-order construct)	Constructs (first-order reflective)	Weights	VIF
IT governance (ITG)	Decision-making structure (ITGD)	0.320***	2.150
	Formal process (ITGF)	0.426***	2.516
	Communication approach (ITGC)	0.371***	2.481

Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

statistically significant to explain ITC. Thus, H1c is supported. Our proposed model explains 74.0% of the variation in organizational agility (OA). IC ($\hat{\beta} = 0.471$; $p < 0.01$), ITC ($\hat{\beta} = 0.260$; $p < 0.01$), and the moderation effects of MT on IC ($\hat{\beta} = -0.258$; $p < 0.01$), ITG ($\hat{\beta} = 0.181$; $p < 0.01$), and ITC ($\hat{\beta} = 0.151$; $p < 0.01$) are statistically significant in explaining OA. Consequently, H2, H3, H4a, H4b, and H4c are supported. Only hypothesis H1a is not supported, which shows that IC and ITC are full mediators between ITG and OA (see Table 6). In summary, out of six hypotheses, our model confirms five.

Regarding the moderating effects, we found that the effects of MT on the relationships between ITG, IC, ITC, and OA are mixed. In Figure 3, the effect of IC on OA is high when market turbulence is low. Conversely, ITG exerts a strong effect on OA when MT is high, as shown in Figure 4. That is also true for ITC, as Figure 5 shows that ITC has a higher influence on OA when MT is high. Thus, when MT increases, the importance of ITG and ITC increases, while that of IC decreases.

Discussion

Even though there is scarce literature that considers the relationships between IT governance and IT capability and innovation capability, the area of research between organizational agility and IT governance is even scarcer. To address that gap, we investigated the effects of IT governance on organizational agility, whether directly or

indirectly. Drawn from prior IS research, we have two research questions that drove this study: (i) **how IT governance influences organizational agility**, and (ii) **how market turbulence moderates this influence?** Our study addressed these questions by developing a theoretical model and empirically testing it. The research model has IT governance as an antecedent to organizational agility. We also posited that IT capability and innovation capability mediate that relationship. We discuss the interpretation of the data analysis and avenues for future research below. The survey data collected from 132 senior managers support the proposed research model, thus validating our theoretical development for our study.

IT governance mechanisms ensure a strategic alignment between IT objectives and business objectives. The alignment would result in having the necessary IT capability that serves the business objectives. One of these objectives is to be agile and capable of sensing and responding quickly and effectively to market changes. Firms with effective IT governance are more likely to practice efficient utilization of their IT capability. IT governance to IT parallels the effect of corporate governance on business (Guldentops et al., 2003). It provides a framework to assist the board and senior management in ensuring that IT capability supports business objectives with a higher return on IT investment and better risk management (Ajamieh et al., 2016; Wilkin & Chenhall, 2010). In that context, senior business managers are responsible for determining IT decisions that result in IT prioritization and

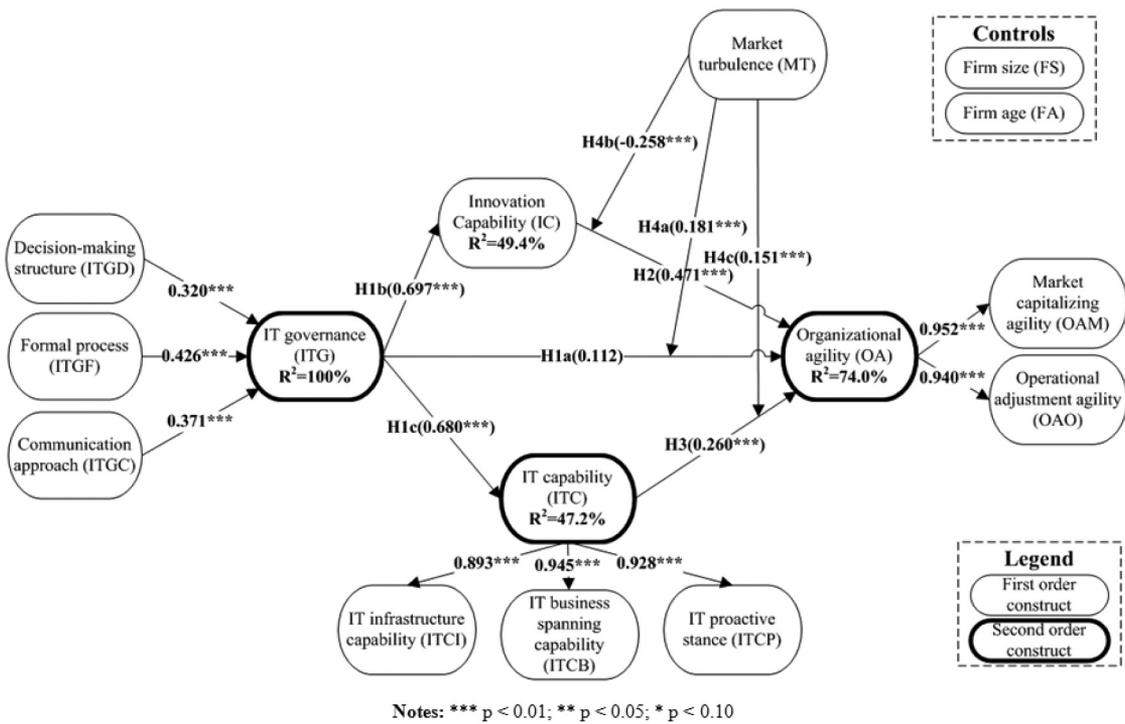


Figure 2. Results of the research model.

investment decisions. That will have its reflection on reaching the desired level of organizational agility. The dynamic development and acquisition of the needed IT capability associated with the required innovative practice will enable the firm to achieve an agile state that can counteract changing market conditions. IT governance requires validation of the business value of IT that can act as an enabler for innovation. Hence it is considered a balanced approach where stability is not regarded as a barrier but rather as an enabler for creativity.

Our study has five notable findings. First, it shows that IT governance can exert a powerful impact on organizational agility through its influence on the innovative practice of the firm. The management controls imposed through IT governance mechanisms ensure that the dynamic IT infrastructure will facilitate the desired innovation practice (Tiwana & Konsynski, 2010). The relationship between IT governance and innovation dates back to the impact of the board of directors or senior management on the innovation practice of the company and its business units

(Asensio-López et al., 2019). Some senior managers would take a proactive and exploring approach to remain the lead competitor, while others would take a reactive and exploiting approach to maintain their competitive status (Ashurst et al., 2012). Either way, strategic innovation needs the service infrastructure to realize the business value of IT in supporting or driving the innovation process (Peterson, 2004). IT governance enforces the strategic alignment between business and IT objectives (Alreemy et al., 2016). That strategic alignment enhances the innovation process, whether in current practice or when facing changing market conditions. It comes with the advantage that both exploring and exploiting the core organizational resources would stimulate the innovation process (Tallon & Pinsonneault, 2011). It also provides

Table 6. Significance analysis of the direct and indirect effects.

Effect of	Direct effect	Indirect effect	Interpretation
ITG → IC → OA	0.112	0.328***	Indirect-only (full mediation)
ITG → ITC → OA	0.112	0.177***	Indirect-only (full mediation)

Notes: *** p < 0.01; ** p < 0.05; * p < 0.10

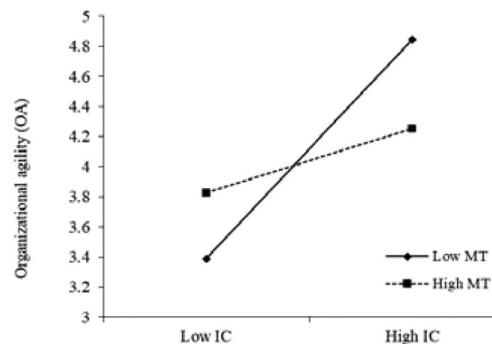


Figure 3. Moderation effect of MT and IC on OA.

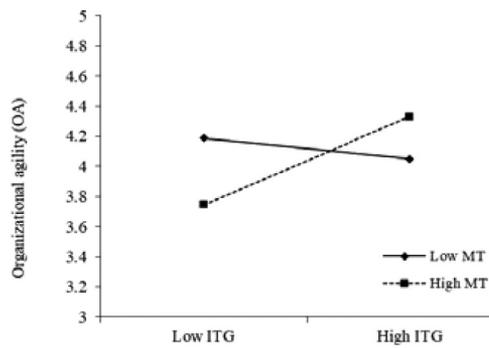


Figure 4. Moderation effect of MT and ITG on OA.

a reasonable assurance for business continuity and in-effect innovation continuity when threatened by undesirable risks.

Second, our study also shows that IT governance can exercise a powerful influence on organizational agility through its impact on IT capability. One of IT governance's main concerns is having efficient management of the firm's IT capability (J. Lee & Lee, 2008). IT governance provides the ability to choose among different options of using IT capability and, as a result, to have monitoring controls that allow a smooth transformation from one IT capability state to another. IT governance provides the ability to do the right thing while doing things right. That is the desired behavior under normal conditions and more in a turbulent environment. IT governance and dynamic capabilities allow the firm to become more flexible and agile when using digital technologies, whether adapting, reconfiguring, or implementing new technologies, systems, and applications. Hence, IT governance provides better management and utilization of IT capability, making it flexible and ready for any needed changes in unpredictable market conditions. Firms possessing more effective IT governance are likely to have more effective and efficient IT capability. As IT governance complements traditional dynamic capabilities (Khalil & Belitski, 2020; Rai et al.,

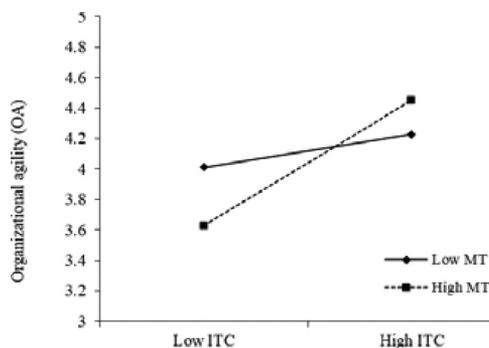


Figure 5. Moderation effect of MT and ITC on OA.

2006; Sarker et al., 2012), it would enable the firm to mitigate the risks in the digital environment (Helfat & Peteraf, 2003). As dynamic capabilities facilitate enhanced IT-business alignment, some scholars argue that IT governance is, in essence, one of the dynamic capabilities since it can provide organizations with the ability to sense and respond quickly and effectively (H eroux & Fortin, 2018).

Third, our study indicates that IT governance positively influences organizational agility with high market turbulence. Market turbulence poses challenges and various pressures that affect the governance of decision-making processes by demanding new resources and capabilities from the organization (Y. Xue et al., 2008). The response may require improving operational efficiency with more IT investment. Such pressure would mandate the company to rely on its specialized department, such as IT, which controls the resources and capabilities that support critical business processes. Acting under different conditions, such as complying with market regulations imposed by the government or emulating successful competitors, requires early recognition and anticipation of market changes. That also requires an early and rapid response, i.e., an appropriate transformation process that aligns IT objectives with business goals. Although these are different types of pressures, there is a similar logic by which they impact organizational governance and, in turn, IT governance. There is a delicate balance in the decision-making process between the IT unit and the business unit that can shift in either direction.

The fourth finding is that IT capability has an increased influence on organizational agility in the event of high market turbulence. Companies with higher IT capability tend to outperform their competitors (Bharadwaj, 2000) because they can identify and respond to market changes better than competitors. They can transform their internal processes and even change their business model. Transforming a core business process or changing the business model in response to market turbulence requires that companies have appropriately skilled personnel, critical resources, and the ability of current IT systems to adapt within acceptable costs.

Fifth, contrary to the previous two findings, the effect of innovation capability is high on organizational agility when market turbulence is low. Innovation capability can counter the threat of competitive innovation, including innovation opportunities that may emerge (Helfat & Raubitschek, 2018). It enables the company to be alert and to identify market turbulence at an early stage. Therefore, it is a significant factor for long-term success, especially in constantly changing markets

(Jiménez-Jiménez & Sanz-Valle, 2011). Early recognition of market changes and rapid innovative responses enable the company not only to deal with unforeseen threats but, more importantly, to take advantage of opportunities as they arise. Creative responses range from changing business processes to creating new business models. In addition, innovative approaches to providing new products and services in response to customer preferences are becoming increasingly realistic. Those unable to do so will quickly lose the market to their competitors (Zhou et al., 2019).

Implications for research

Our research provides several contributions to the IS discipline. First, it examines and demonstrates how the two theories RBV and DCV combined can explain the impact of IT governance on organizational agility under market turbulence. Both RBV and DCV are two views that allow us to understand how firms can achieve organizational agility using resources and capabilities. The RBV emphasizes that firms with valuable, rare, inimitable, and non-substitutable resources will maintain their agile state over a predictable and sustained period. RBV has been used in information systems research to explain how IT business value can provide a competitive advantage (Bharadwaj, 2000). The RBV highlights how firm resources such as IT can be the main predictors of a firm's performance (Barney, 1991). Looking through the RBV lens, the model explains how IT governance, innovation capability, and IT capabilities are potential sources for organizational agility.

However, RBV is limited to a static environment and doesn't explain the response to rapid and unpredictable market conditions (Eisenhardt & Martin, 2000). The dynamic capabilities compensate for that limitation by emphasizing how firms can use their internal resources and external capabilities to sustain their agility in a dynamically unpredictable environment. The DCV extends the RBV by explaining how dynamic capabilities can govern when faced with turbulent market conditions (Teece et al., 2016). These capabilities include sensing, responding, and transforming resources to enable the firm to explore and exploit market opportunities and manage new unpredictable threats. Hence, extending the RBV with the DCV can explain how IT governance can impact IT capability, innovation capability, and organizational agility. It can also explain how market turbulence can influence that impact. With market changes, the dynamic capabilities can enable firms to build and reconfigure their resource base; thus, helping them to manage emerging opportunities or impending threats.

Second, we showed that IT governance has an important role when facing the moderating influence of market turbulence. That enabled us to understand the paradox in this relationship. While IT capability requires flexibility and the ability to transform and respond quickly to market changes, IT governance requires standardization and stability. Prior research on studying the impact of IT governance on IT capability is very scarce. Furthermore, there are limited studies that examine the moderating influence of market turbulence on such a relationship. The significance of such an impact seems essential and critical with new and emerging technologies and the innovative practice in implementing them. Effective management of IT capability can provide the firm with higher performance under different market conditions. That explains why IT governance is used by senior management and the board of directors to manage and control IT capabilities, as it will enable them to realize the desired benefits that are critical to achieving the business objectives. Effective IT governance provides a management framework for IT capability. That ensures having controls that allow monitoring and guided transformation from one IT capability state to another. Hence, IT governance provides better management and utilization of IT capability. That will enable the firm to sense and respond in a better manner to changing market conditions with enhanced agility. IT governance acts as an antecedent to IT capability.

Third, it is challenging to achieve strategic innovation without realizing the business value of IT in supporting or driving the innovation process (Peterson, 2004). The ability to both explore and exploit critical organizational resources in a dynamic environment would enhance the innovation process. Sensing market changes and responding with rapid innovations will enable the firm to minimize potential threats and capitalize on emerging opportunities. The ability to explore and exploit innovative technologies and practices vary from creating new products and services, changing core business processes, or even changing the business model. The management control imposed through IT governance mechanisms will ensure that the current IT infrastructure will support the desired innovative practice.

Fourth, effective IT governance also provides a reasonable assurance for maintaining business continuity and in-effect innovation continuity when threatened by market changes. Our study shows that IT governance acts indirectly on organizational agility through mediation by innovation capability. IT governance provides the framework where innovation can thrive and exert its effects even under market turbulence. The findings of our study have demonstrated the

theoretical implication of information technology governance and its positive impact on organizational agility mediated by the innovation capability of the firm.

Implications for practice

Regarding the professional aspect, managers may need to consider their appropriate IT governance mechanisms best suited for their practice to ensure alignment between IT and business objectives, including the desired agility. That will enable both IT capability and innovation to contribute positively to business objectives under a turbulent environment. This study provides several practical insights to senior management, IT executives, and auditors.

First, IT governance provides a framework that enhances managing the firm's IT capability in the best optimal way. Effective IT governance has a significant impact on developing and acquiring new IT capability, a step to achieve organizational agility. Our study emphasizes the need for effective IT governance to cover existing technologies or new and emerging ones that can disrupt the business environment and make current IT capability obsolete.

Second, our study provided evidence that IT governance is a critical antecedent for stability when innovative practice is needed. That means it acts more as an enabler than a barrier to creativity. IT governance framework provides a governed path for innovation capability to achieve desired organizational agility. That will provide reasonable assurance for having management controls when the firm changes from one state to another. That provides the needed support to achieve the innovation objectives of the company, whether in current practice or upcoming plans. In other words, it will enable a governed, innovative manner to transform business activities successfully in a dynamic environment.

Third, IT governance requires the approval of senior business managers for the deployment of the assigned IT management controls. IT auditing is one of these management control practices exercised by the board and senior management over IT capability. Hence, IT auditors need to consider the importance of IT governance mechanisms that oversee the preparation of IT capability required under turbulent conditions. IT auditors need to assess the designated management controls, including the sensing and responding ones. That will enable guarding against unpredictable market changes. They need to consider the crucial management controls for IT governance in a dynamic environment, including the most critical, that is, the alignment of IT and

business goals. They need to identify the design factors suited for the specific context of the enterprise in such a dynamic environment (De Haes et al., 2020).

Fourth, effective IT governance provides a reasonable assurance for maintaining business continuity and in-effect innovation continuity when threatened by market changes. Exploiting and exploring innovative practices require dynamic management control to render any digital transformation as safe and smooth as possible.

Limitations and future research

Our study has some limitations that can serve as opportunities for future research. First, we used cross-sectional data to evaluate the impact of IT governance mechanisms on organizational agility and having innovation capability and IT capability as critical mediators. It would be helpful to conduct longitudinal research on related specific antecedents of effective IT governance and other relevant mediators to have more information on other key agility antecedents under market turbulence.

Second, in the era of Industry 4.0 technologies, IT governance mechanisms may not cover some IT activities that interface with external IT capability. It is a limitation in current practice where some activities dependent on the firm's IT capability exist outside the firm, e.g., digital platforms, outsourcing, and open-sourcing (Aubert & Rivard, 2020). That poses a need to study how IT governance mechanisms can extend their reach externally in a dynamic manner and offer the needed controls.

Third, we relied on a single key respondent. That could suggest that the results may be subject to method bias. It would have been preferable to get multiple respondents per company to enhance validity and reliability. There is always the difficulty of obtaining responses to surveys in field research, especially concerning IT governance. However, we tried to minimize such bias ex-ante and ex-post. On the ex-ante, we assured the respondents of both anonymity and confidentiality of their responses (Rogelberg & Stanton, 2007). We also designed the survey in a clear format avoiding ambiguous terms or complicated questions. We selected the measures of our study to be independent of each other and their expected outcomes. We also changed the design of our questionnaire using the scale reordering procedure (i.e., our dependent variables are after, rather than before, the independent variables) to reduce the effects of consistency artifacts. On the ex-post, we conducted Harman's one-factor test to

determine the extent to which our results are biased. The test suggests that method bias does not account for our study's results.

Fourth, as we conducted our study in Brazil, we understand the need to examine the research model in other countries to generalize it across borders. Future research should explore whether our findings are also valid in different countries. Finally, as medium-to-large firms were the target of our study, there is a need to test if the proposed theory supports small firms.

Conclusion

Our study examines how IT governance affects organizational agility under turbulent market conditions. We theorized that IT governance mechanisms enable the firm to use IT capability more effectively and efficiently. It also provides a stable platform for innovative practice, thus, enabling the firm to become more agile when facing changing market conditions. Our proposed research theory has its roots in two well-established theories; the resource-based view and the dynamic capabilities view. RBV explains how IT governance, innovation, and IT capabilities are potential sources for organizational agility, while DCV explains a firm's behavior under changing market conditions. We tested the proposed conceptual model with a sample of senior managers in medium-to-large firms, and the empirical analysis supports our theory. Our study shows that IT capability and innovation capability fully mediate the effect of IT governance on organizational agility. Our results also show the strong impact of IT governance and IT capability on organizational agility when associated with high market turbulence. However, the effect of innovation capability on organizational agility is high when market turbulence is low.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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