

12-1-2018

## How IT Awareness Impacts IT Control Weaknesses and Firm Performance

Peiqin Zhang

*Department of Computer Information Systems & Quantitative Methods, Texas State University, San Marcos, TX, United States., p\_z13@txstate.edu*

Ju Long

*Department of Computer Information Systems & Quantitative Methods, Texas State University, San Marcos, TX, United States.*

James Ma

*Department of Information Systems, University of Colorado at Colorado Springs*

Follow this and additional works at: <https://scholarworks.lib.csusb.edu/jitim>



Part of the [Accounting Commons](#), [Business Administration, Management, and Operations Commons](#), [Finance and Financial Management Commons](#), [Leadership Studies Commons](#), [Management Information Systems Commons](#), [Organizational Behavior and Theory Commons](#), [Organization Development Commons](#), [Other Business Commons](#), and the [Science and Technology Studies Commons](#)

---

### Recommended Citation

Zhang, Peiqin; Long, Ju; and Ma, James (2018) "How IT Awareness Impacts IT Control Weaknesses and Firm Performance," *Journal of International Technology and Information Management*: Vol. 27 : Iss. 2 , Article 5.

Available at: <https://scholarworks.lib.csusb.edu/jitim/vol27/iss2/5>

This Article is brought to you for free and open access by CSUSB ScholarWorks. It has been accepted for inclusion in *Journal of International Technology and Information Management* by an authorized editor of CSUSB ScholarWorks. For more information, please contact [scholarworks@csusb.edu](mailto:scholarworks@csusb.edu).

# How IT Awareness Impacts IT Control Weaknesses and Firm Performance

Peiqin Zhang,

*(Department of Computer Information Systems & Quantitative Methods,  
Texas State University, San Marcos, TX, United States.)*

Ju Long

*(Department of Computer Information Systems & Quantitative Methods,  
Texas State University, San Marcos, TX, United States.)*

James Ma

*(Department of Information Systems,  
University of Colorado at Colorado Springs)*

## ABSTRACT

*With the prevalence of information technology (IT), the value of IT awareness increasingly grows, and IT control becomes a key part of firms' strategies and objectives. Although leadership plays an important role in IT control governance, limited research has studied whether IT awareness is associated with IT control weaknesses (ITCWs) and firm performance simultaneously. Drawing on the agency and resource dependence theory, this paper proposes an integrative model to examine the impact of IT awareness on ITCWs and firm performance. We empirically validate the model using a data set of 310 firms collected from multiple sources including Audit Analytics, Compustat, 10-K filings, and proxy statement. The findings indicate that firms with higher IT awareness are less likely to have ITCWs, and lead to improved firm performance. This paper contributes to information systems (IS) literature by investigating the IT experience and knowledge of the board of directors on both ITCWs and firm performance. This study also provides important practical implications for IT management practices.*

**KEYWORDS:** IT awareness, IT internal control weaknesses, IT business value, firm performance, competitive advantage

## INTRODUCTION

Nowadays, “every company is a technology company” (Rainer et al., 2014, pp.3). In today’s business environment, organizations are spending large amounts of money on IT because they recognize the tremendous benefits that IT can bring to their operations and services. IT business value literature suggests that IT creates value for the organizations (Brynjolfsson & Hitt, 2011; Chen & Zhu, 2004; Devaraj & Kohli, 2003; Kohli & Grover, 2008). However, IT-generated business value often concurs with risks such as data breach, security, and software error, which could destroy the stakeholders’ confidence and result in negative impact on firm performance. Such risks are not only technical problems of IT, but also internal control issues of management (Cereola & Cereola, 2011; Zhang et al., 2015). Management develops proper internal control procedures to prevent the generation of these risks and to protect firms’ both physic and information assets (Cereola & Cereola, 2011; Shih, 2010), which ensure that their information systems are reliable, secure, and not vulnerable to computer attacks (Frost & Choo, 2017).

IT security audits assess the practices, procedures, technical controls and other resources to reduce security risks by adopting auditing standards (AS). Extant AS have indicated the potential influence of IT on internal controls (Chen et al., 2014). For example, the statement on Auditing Standards (SAS) No. 109 indicates that IT proposes both benefits and risks to internal controls (AICPA, 2006). In addition, AS No. 12 highlights the importance of considering the risks and controls within IT in conducting an audit (PCAOB, 2010). In order to reduce certain internal control risks or weaknesses, U.S. congress enacted the Sarbanes-Oxley Act (SOX) to set more rigorous internal control standards to regulate the public compliance, which has a huge impact on internal controls. AS No. 5 defines the internal control material weaknesses as “a significant deficiency, or combination of significant deficiencies, that results in more than a remote likelihood that a material misstatement of the financial statements would not be prevented or detected on timely basis by the company” (PCAOB, 2007). If the internal control material weaknesses are IT related, they are defined as IT control weaknesses (ITCWs).

The internal control auditing standards have been widely applied to the industry. However, corporate board of directors’ IT awareness is still limited (Andriole, 2009; Deloitte, 2011; Huff et al., 2006; Parent & Reich, 2009; Westby, 2012; Yayla & Hu, 2014). In order to better understand the role of IT awareness, several studies have examined the impact of IT awareness on firm performance (Dehning & Stratopoulos, 2002; Yayla & Hu, 2014; Zhang et al., 2016). Dehning &

Stratopoulos (2002) indicated that managerial IT skills and knowledge are positively related to firm performance. Yayla & Hu (2014) provided the evidence that board of directors with high level of IT awareness can more effectively monitor and better incentivize executives, and consequently lead to better firm performance. The board of directors, responsible for overseeing the activities of an organization, should ensure the organization has a sound enterprise architecture providing a long-term view of the organization's business processes, information systems, and technology infrastructure (Van der Raadt et al., 2010). However, the pace of technological change and the growing complexity of corporate IT environments, have made it difficult for the organizations to ensure alignment between the organization's business strategies and the digital platform built to support these strategies (Bradley et al., 2011; Schmidt & Buxmann, 2011). If directors have the fundamental area knowledge or expertise, they are more aware of the IT-related weaknesses. Therefore, they are more comfortable to provide effective oversight to IT-related internal control risks or weaknesses. They are also more likely to effectively monitor the company's leadership in utilizing IT assets to realize the IT/business alignment. Zhang et al. (2016) suggested that IT leadership impacts firm performance through IT capability. Leadership has been rated as the most important critical successful factors for the organizations (Sung & Gibson, 1998).

Prior literature has examined the influences of IT experience and knowledge from two streams. One stream of literature examines the effect of IT control governance on ITCMs (Li et al., 2007; Zhang et al., 2018). A second stream of literature investigates whether high level of IT awareness can help firms achieve superior firm performance (Yayla & Hu, 2014). However, to the best of the authors' knowledge, previous research has not provided a corporate-level view of IT awareness impacts on both ITCWs and firm performance. From operational perspectives of enterprise IT, considerable research has been devoted to study the benefits of various IT control governance mechanisms and made important contributions (Boh & Yellin, 2006; Cram et al., 2015; Foorthuis et al., 2016). These studies have not examined internal IT controls at the corporate level, despite the importance of leadership in building enterprise IT and IT control governance. To fill this research gap, this study proposes an integrative model to address the following research questions: (1) How is IT awareness related to ITCWs at the corporate level? (2) How does IT awareness impact firm performance at the corporate level? To answer these questions, we draw upon agency theory and resource dependence theory to develop our research model. Agency theory explains the relationship between principals and agents (Eisenhardt, 1985; Eisenhardt, 1989). An agency problem occurs in a situation of goal incongruence between the principals and agents. In the context of SOX 404, the principal is the board of directors who delegate the responsibility of corporate governance including internal

controls over financial reporting. The agent is the top information system (IS) executives delegates the responsibility of IT control governance (Hamdan, 2011). Without goal agreement between board of directors and IS executives, firms are more likely to have ITCWs due to the lack of IT skills and knowledge by board of directors. Based on resource dependence theory, board of directors with IT knowledge and experience would provide important resources for the company through their experience, know-how, and professional networks (Yayla & Hu, 2014).

Using a sample of U.S. firms collected from multiple sources including Audit Analytics database (SOX 404 reports), Compustat, 10-K filings, and proxy statement, we empirically validate the proposed research model. We find that higher level of IT awareness of board of directors can help to mitigate ITCWs. We also provide the evidence that effective IT awareness has positive impact on firm performance.

The remainder of the paper is organized as follows. Section two presents an institutional background. Section three introduces the theoretical background and develops hypotheses for the study. Section four describes the relevant variables and presents the proposed research model. The research methods and data collection procedures are then illustrated in section five. Section six summarizes the empirical findings, while the paper closes with a discussion of the study's contributions, implications for future research, and concluding comments.

## INSTITUTIONAL BACKGROUND

### *SOX, Internal Controls, and IT Internal Controls*

Massive business failures and accounting frauds in companies such as Enron, WorldCom, and Tyco international destroyed the investors' faith and resulted in huge financial loss for stakeholders due to the lack of internal controls. As a reaction to these accounting frauds, U.S. congress has enacted the SOX Act on July 30, 2002 to provide more enhanced and rigorous accounting standards, and place restrictions on executive officers and directors of public firms (Carter et al., 2012; PCAOB, 2004; Zhang et al., 2018). The SOX act detailed the requirements and responsibilities as well as possible penalties for non-compliance.

Under the SOX Act section 302, the corporate management are required to certify in the periodic reports (10Qs and 10Ks) that they have reviewed the report and the effectiveness of the internal controls systems, and they have identified material

changes in internal controls (Beneish et al., 2008; Zhang et al., 2018). Under the SOX Act section 404, all public companies are mandated to disclose their internal control deficiencies. Management is also required to provide an internal control report and assess the effectiveness of their organizations' internal controls that is attested to by the company's public accountants. In addition, the auditors are required to attest to, and report on, management's assessment of its internal controls (Shan & Troshani, 2014; Zhang et al., 2018).

Internal controls are key components of the SOX Act of 2002, and have been perceived as an important issue of an organization to instill investor's confidence (Carter et al., 2012). Internal controls are a set of policies, procedures, and organizational practices, effected by an entity's board of directors, management and other personnel. A firm implements the control to reduce risks and provide reasonable assurance regarding the achievement of four broad objectives: (1) to safeguard assets of the firm; (2) to ensure the accuracy and reliability of accounting records and information; (3) to promote efficiency in the firm's operations; (4) to measure compliance with management's prescribed policies and procedures (Hall, 2011; SEC, 2003).

The SOX Act of 2002 also highlights the importance of IT internal controls (Li et al., 2012). IT drives the modern organizations' business operations. Automated information systems initiate, authorize, record, and report the financial transactions. Such systems are embedded into the business financial reporting processes (Hall, 2011). Effective internal controls over information systems have therefore been recognized as an integral part of reliable financial reporting by managers, regulators, and auditors. The Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework identifies two broad categories of IT internal controls. They are application and general controls. Application controls aim to ensure the validity, completeness, and accuracy of financial transactions, such as account receivable, account payable, and payroll. General Controls include controls over IT governance, IT infrastructure, security and access to operating systems and databases, data management, system maintenance, program change procedures, and application development (Hall, 2011). General controls apply to all systems and affect transaction integrity. For example, if an organization has insufficient access control to their system, the data might be at risk of being changed or stolen. Therefore, IT internal controls play a critical role to ensure the reliability and integrity of financial transactions.

## THEORETICAL BACKGROUND AND HYPOTHESES

### *IT Awareness and ITCWs*

Agency theory has been extensively used in different areas including accounting, finance, economics, and marketing. Drawing on this theory, principals and agents have different goals (Eisenhardt, 1985; Eisenhardt, 1989). An agency problem occurs in a situation of goal disagreement between the principals and agents. In the context of SOX 404, the board of directors are principals who delegates to the top management team the responsibility of IT governance including IT internal controls. The top IS executives are agents to whom the top management team delegates the responsibility of IT control governance (Hamdan, 2011). If it is lack of the resources such as IT experience and skills, specifically IT awareness, it may cause delegation. If the principals (board of directors) and the agents (IS executives) have incongruent goal, board of directors may not provide effective monitoring function on top IS executives' behavior in IT implementation and controls. Hamdan (2011) indicated that specialized IT knowledge and experience are necessary to govern IT controls over financial reporting. Therefore, firms are more likely to experience ITCWs if board of directors are lack of IT skills and knowledge. On the contrary, if board of directors have IT background or experience, they are more likely to have higher IT awareness, which could help to reduce risks of data tampering, data loss or leakage, service disruption, and poor management of IT systems. Therefore, we propose the following hypothesis:

*H1. IT awareness is negatively associated with ITCWs.*

### *IT Awareness and Firm Performance*

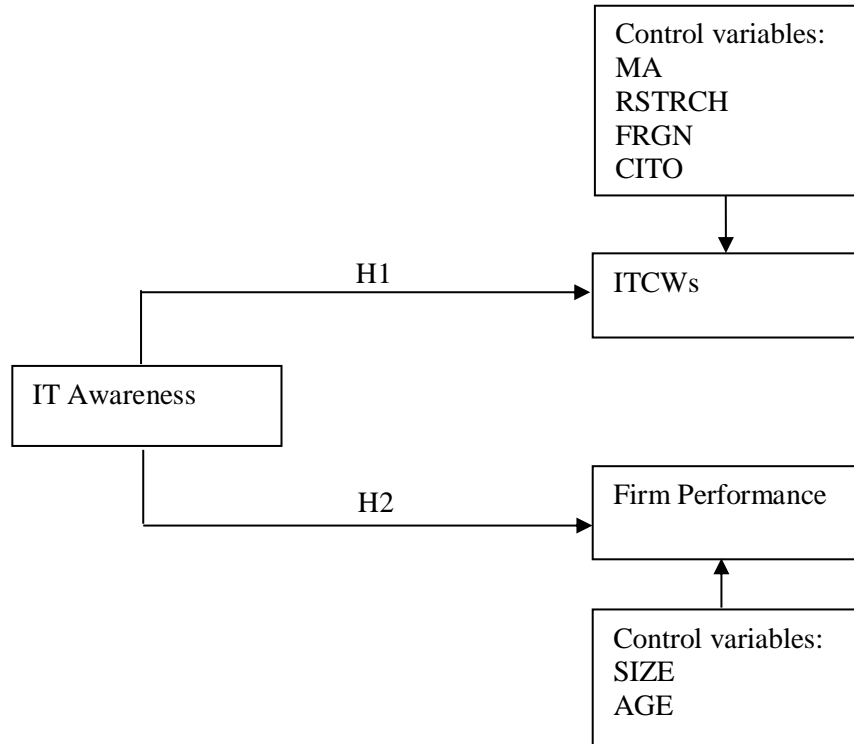
Resource dependence theory has been used to explain the relationship between board capital and firm performance (Hillman & Dalziel, 2003; Yayla & Hu, 2014). Drawing upon this theory, board of directors can bring their companies' important assets such as IT-related skills, experience, expertise, knowledge, IT processes, and professional networks (Yayla & Hu, 2014). IT-related assets have been embedded in an organization's operations and strategies, such as transactions, processes, and services. Research indicates that a significant portion of the business value generated by IT results from complementarities between IT and organizational practices (Basu & Jarnagin, 2008; Brynjolfsson & Hitt, 2000; Chi et al., 2017; Zhang et al., 2016). High level of IT awareness of board of directors could help to better utilize IT assets to achieve superior firm performance. Therefore, companies with high level of IT awareness may maintain unique assets in IT resources, and lead to competitive advantage comparing to their competitors.

In addition, organizations' board attributes including insider representation, board size, and IT competency affect a board's involvement in IT governance. This suggests that board involvement could improve organizational strategy and avoids risks, which in turn impacts firm performance (Alreemy et al., 2016; Jewer & McKay, 2012; Judge & Zeithaml, 1992; Zhang et al., 2016). Board's independence, size, and composition (insider and outsider) determine the board effectiveness in its monitoring function (John & Senbet, 1998; Zhang et al., 2018), and the oversight function could control the formulation and implementation of the IT strategy. If companies with strong oversight function, their outside and independent boards are more likely to effectively monitor the firm's internal boards and its leadership in utilizing IT assets to realize IT/business alignment. We argue that board of directors with high level of IT awareness may have more effective oversight function, and could better manage and utilize IT. This will enhance the decision making and monitoring capabilities of the board, and result in better firm performance (Kroll et al., 2008; Sundaramurthy & Lewis, 2003). This leads to the following hypothesis:

*H2. IT awareness is positively associated with firm performance.*

Based on the above hypotheses, IT awareness plays a role in mitigating ITCWs and helps to improve firm performance. The research model of this study is summarized as shown in Figure 1. We follow the research model that Yayla & Hu (2014) used to investigate the effect of board of directors' IT awareness on CIO compensation structure and firm performance. They found that there is a positive association between IT awareness and firm performance. Their findings indicated that there is no relationship between IT awareness and CIO compensation. They also suggested that IT intensity of industry moderate the relationship between IT awareness, CIO compensation, and firm performance. While our model is different from that of Yayla & Hu (2014) in two folds. First, we focus on the ITCWs instead of CIO compensation in our model because it is important for organizations, investors, regulators, and related stakeholders to understand ITCWs. Understanding of ITCWs may help organizations take appropriate actions to remediate ITCWs in a timely manner. Understanding of ITCWs may also help investors make investment decisions very carefully. Furthermore, understanding of ITCWs could help regulators enact and update policies and standards to provide the assurance of reliability and integrity of the organization's operations. Second, the model describes whether IT awareness helps to mitigate ITCWs for safeguarding firms' information assets and to enhance firm performance simultaneously.



**Figure 1: The proposed research model**

## VARIABLE DEFINITION

In this section, we discuss the definition and measurement of all the variables identified in this study.

### *Firm Performance*

Market valuation has been widely used in the literature to represent market expectations of the firm's future performance (Kuhn et al., 2013; Stoel & Muhanna, 2011). We choose market valuation because market value is a forward looking, risk-adjusted measure of firm performance. Consistent with previous literature (Kuhn et al., 2013; Stoel & Muhanna, 2011), market valuation is calculated as:  $MV = (\text{closing price of share at the end of the fiscal year}) \times (\text{number of common shares outstanding})$ .

### *IT Control Weaknesses (ITCWs)*

Under the SOX Act Section 404, all publicly traded firms are mandated to disclose deficiencies in internal controls over financial reporting. The most severe type of internal control deficiencies (ICDs) is referred to as the internal control material weakness. It is defined by Auditing Standard (AS) No. 5 as “a significant deficiency, or combination of significant deficiencies, that results in more than a remote likelihood that a material misstatement of the financial statements would not be prevented or detected on timely basis by the company” (PCAOB, 2007; Zhang et al., 2015; Zhang et al., 2018). If the material weaknesses are IT-related, they are coded as ITCWs. If firms disclose at least one ITCW, their IT-related controls are considered ineffective and of low quality (Li et al., 2007; Zhang et al., 2018). ITCWs are coded as 1 if a firm discloses ITCWs in the SOX 404 in year  $t$ , and 0 otherwise.

### *IT Awareness*

Yayla and Hu (2014) proposed the construct of IT awareness to capture the IT knowledge and experience of the board of directors. IT awareness was defined as “the extent to which the board of directors are conscious of IT as a business function and able to formulate appropriate conceptions of what IT entails to their firm and industry” (Yayla & Hu, 2014, pp. 403). Consistent with the literature, we measure the IT awareness as the percentage of board of directors with IT experience and knowledge (Yayla & Hu, 2014).

### *Control Variables*

Based on a review of prior literature on IT investment, IT governance, IT business value, and firm performance (Bharadwaj et al., 1999; Bharadwaj, 2000; Ravichandra et al., 2009; Stoel & Muhanna, 2011; Zhang et al., 2016), this study controls for firm size and age which may have impacts on firm performance. In addition, we control for mergers and acquisitions, restructuring, foreign sales, and CIO or CTO position, which may affect ITCWs. Table 1 summarizes the definition and description of the variables in the model.

**Table 1: Definition of variable**

Variables	Observable measures	Definition and description
ITCWs		1 if the company disclosed ITCWs in the SOX 404 report; 0 otherwise.
Market Value		(closing price of share at the end of the fiscal year) *(number of common shares outstanding).
ITAW		Percentage of board of directors with IT experience.
Control variables	SIZE	Natural logarithm of the total assets of the company.
	AGE	Log of the number of years the company has CRSP data.
	MA	1 if a company has been involved in a merger or acquisition over the previous three years
	RSTRCH	1 if a company has been involved in a restructuring in previous three years; 0 otherwise.
	FRGN	1 if a company reports foreign sales in year t; 0 otherwise.
	CITO	1 if a firm has CIO or CTO position; 0 otherwise.
ITCWs = IT control weaknesses ITAW = IT awareness MA = merger or acquisition RSTRCH = restructuring FRGN = foreign sales CITO = CIO or CTO position		

## RESEARCH METHODOLOGY

### *Data Sources and Collection*

The data collection started with the Audit Analytics database (SOX 404 reports). We first identified the initial sample of the companies that disclose the effectiveness of internal controls in their annual reports. We then searched firms' SEC 10-K filings to identify whether they have control weaknesses disclosure or not. If the firm has control weaknesses, we then determined whether the control weaknesses are IT-related based on the process and examples suggested by the literature (Masli et al., 2009; Zhang et al., 2018).

We retrieved the firm performance data from the annual Compustat database and firm stock data from the CRSP database. We collected the IT awareness data from a combination of proxy statement database, 10-K filings, and Mergent online database (Zhang et al., 2018). Proxy statement database requires companies to report the biographical information of each director including name, title, and experience (Lim et al., 2013; Klein, 2002; Zhang et al., 2018). SEC 10-K filings and Mergent online databases also provide the biographical information of executive officers and board of directors. We used all three databases to obtain the IT experience data of each board of directors. We then calculated the percentage of board of directors with IT experience.

The data from the year 2010 to 2011 were collected and used for this study. Due to the availability and feasibility of data collection, we ended our data collection in the year 2011, since the most recent financial data publicly available in Compustat Database were only until 2011 before we finalized our study.

Consistent with prior research, we chose the control firms by matching the industry code (SIC code) and firm size (total assets) during the year when ITCWs were reported (Li et al., 2007; Purnanandam & Swaminathan, 2004; Zhang et al., 2018). Since the firms disclosing ITCWs also have general weaknesses, the control group consisted of companies with non-IT related control weaknesses but with general weaknesses (Zhang et al., 2018). The final sample yields 310 firms composed of 155 firms disclosing ITCWs and 155 firms with non-ITCWs. Since ITCWs is a binary variable, a logistic regression analysis is performed to predict ITCWs. Consistent with the literature in the field (Carter et al., 2012), an ordinary least squares (OLS) is used to predict firm performance. We checked the data for multicollinearity and normality of the distribution. We found that there is no multicollinearity problem of the explanatory variables. The errors are normally distributed. Therefore, OLS is an optimal method to predict firm performance.

## DATA ANALYSIS AND RESULTS

### *Descriptive Statistics*

Table 2 provides the descriptive statistics of key variables in the current study by listing the mean, standard deviation, median, minimum, and maximum of each variable.

**Table 2: Descriptive statistics**

	Mean	Std.Dev	Median	Min	Max	N
Market value	179.045	604.630	30.849	.066	7577.06	310
ITCWs	0.501	0.500	-	0	1	310
ITAW	0.267	0.294	0.2	0	1	310
SIZE	2.427	3.258	2.758	-8.747	9.495	310
AGE	14.78	12.762	12	0.083	86	310
MA	0.598	0.491	-	0	1	310
RSTRCH	0.251	0.434	-	0	1	310
FRGN	0.505	0.500	-	0	1	310
CITO	0.082	0.276	-	0	1	310

Table 3 presents the Pearson correlations among the main variables and variance inflation factor (VIF) diagnostic. Table 3 - Panel A shows that most of the values of correlations are small, falling below  $\pm 0.3$ . However, the largest correlation is 0.401 between FRGN and SIZE, followed by 0.377 between MA and SIZE, and 0.359 between RSTRCH and SIZE. To detect the possibility of multicollinearity, we also conduct the VIF test. The results are reported in Panel B of Table 3. The VIF of the independent variables is found to be less than 2, which are far less than 10 (Gujarati, 2003). Therefore, there is no evidence of multicollinearity issue in the estimation.

**Table 3: Collinearity diagnostics**

	Market Value	ITCWs	ITAW	SIZE	AGE	MA	RSTRCH	FRGN	CITO
Panel A: Pearson correlations									
Market Value	1.000								
ITCWs	.085	1.000							
ITAW	.198 ***	-.129 **	1.000						
SIZE	.370 ***	.041	.197 ***	1.000					
AGE	.088	.109 *	-.172 ***	-.115 **	1.000				
MA	.148 **	.024	.112 *	.377 ***	-.184 ***	1.000			
RSTRCH	.152 ***	.117 **	.158 ***	.359 ***	.042	.167 ***	1.000		
FRGN	.158 ***	.100 *	.115 **	.401 ***	-.186 ***	.184 ***	.192 ***	1.000	
CITO	.038	-.151 ***	.167 ***	.172 ***	-.134 **	-.034	-.029	.072	1.000
Panel B: VIF diagnostics									
VIF	1.22	1.08	1.15	1.68	1.15	1.22	1.20	1.24	1.11

Notes: \*\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*\* . Correlation is significant at the 0.05 level (2-tailed).

\* . Correlation is significant at the 0.1 level (2-tailed).

a. Listwise N = 310

### ***Empirical Results***

To test Hypothesis 1, since the dependent variable is binary variable, we employ logistic regression analysis to model the probability of reporting ITCWs as a function of IT awareness. The empirical results are shown in Table 4 - Panel A. A test of full model with predictors against a constant-only model is statistically

reliable with  $\chi^2$  (5, N=310) = 18.63,  $p < 0.01$ . It indicates that the predictors reliably distinguished between firms with ITCWs and firms without ITCWs. Table 4 - Panel A displays the regression coefficients and standard errors for each predictor. According to the results, after controlling for firms' merger or requisition, restructuring, foreign sales, and CIO or CTO position, we find that IT awareness is negative (-0.996) and significantly associated with ITCWs ( $p < 0.05$ ), which suggests that firms with higher IT awareness are less likely to have ITCWs. Therefore, the results provide support for Hypothesis 1. The findings empirically validate the leadership role of IT awareness, which is consistent with the results from the prior research (Li et al., 2007; Zhang et al., 2018). Our result suggested that the board of directors with strong IT awareness could help to reduce ITCWs. The influence of leadership from the board of directors is also congruent with the findings of previous studies related to IT controls at the operational level. Among them, Foorthuis et al. (2016) showed that management involvement and knowledge exchange are significant factors to ensure business/IT alignment. It can be reasonably believed that the effects of IT awareness cascaded throughout the organization, as the leadership was able to provide better involvement and to facilitate knowledge management for a firm's practices of IT control governance. The low R-squared in this regression indicates that board of directors' IT awareness explains a small portion of the variation in ITCWs. This is not surprising, since the responsibility of the board of directors is to monitor the top management's behavior and review the firms' documents, but not to participate in corporate-wide governance on a daily basis. The IS executives and employees are practically in charge of designing and implementing IT internal controls in complex corporate environments. Nonetheless, our analysis reveals significant impacts of board of directors' IT awareness on ITCWs.

To test Hypothesis 2, we follow the previous research using an ordinary least squares (OLS) estimation to test the impact of IT awareness on firm performance (Carter et al., 2012). Table 4 - Panel B provides the OLS results. According to the results, after controlling for the firm size and age, we find that the estimated coefficient of IT awareness is positive and partially associated with firm performance ( $p$ -value = 0.057), which indicates that firms with higher IT awareness are more likely to achieve competitive advantage and result in better performance. Thus, Hypothesis 2 is partially supported by the data. The result is consistent with the findings of Yayla and Hu (2014), where they suggested that board of directors' IT awareness helps not only to monitor IT-related decisions more effectively, but also to achieve better firm performance. Our study, focusing on firms' ITCWs and performance, demonstrated new evidences of the IT awareness's positive effects on the monitoring function of board of directors.

With respect to control variables, we find that firm size has significant impact on firm performance, which indicates that larger firms are more likely to perform better. Compared to firms with non-ITCWs, ITCWs companies are more likely to undergo restructuring, have foreign sales, and are less likely to have CIO or CTO position.

**Table 4: Empirical results**

	Predicted sign	Coefficient	(Std. Err)
Panel A: Dependent variable = ITCWs			
Intercept		.001	(.228)
ITAW	- [H1]	-.996**	(.435)
MA		-.018	(.255)
RSTRCH		.570*	(.293)
FRGN		.440*	(.252)
CITO		-1.110**	(.504)
Industry Effect	Yes		
Pseudo R <sup>2</sup>	4.62%		
N	310		
Panel B: Dependent variable = Market value			
Intercept		-175.497	(117.990)
ITAW	+ [H2]	317.122*	(166.067)
size		66.273***	(18.014)
age		7.375	(6.205)
R <sup>2</sup>	17.6%		
N	310		

Notes: \*\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*\* . Correlation is significant at the 0.05 level (2-tailed).

\*. Correlation is significant at the 0.1 level (2-tailed).

a. Listwise N = 310

## DISCUSSION AND CONCLUSIONS

This paper empirically examines how IT awareness of the board affects both ITCWs and firm performance. After controlling a number of firm characteristics, this study provides the insights that there is a negative relationship between IT awareness and ITCWs, and a partially positive association between IT awareness and firm performance. Table 5 provides the summary of the findings of the current study.



**Table 5: Results of hypotheses testing**

Hypothesis	Expected Sign	Finding	Implication
H1: IT awareness → ITCWs	-	Significant	IT awareness has negative effect on ITCWs.
H2: IT awareness → firm performance	+	Partially Significant	IT awareness has positive effect on firm performance.

We believe that this study contributes to the accounting information systems (AIS) and management information systems (MIS) literature in several ways. First, the findings of this study showed new evidences of IT awareness's influences associating IT experience of the board of directors with both ITCWs and firm performance at the corporate level. Moreover, the study provided new insight into IT knowledge's impacts on leadership for effective corporate governance, while empirically validating the importance of board of directors' IT awareness in mitigating ITCWs, and leading to superior firm performance. Second, this study contributes to the AIS literature on IT internal controls by empirically investigating the IT internal controls quality and its antecedents. Third, our study also contributes to the MIS literature with a measurement of IT awareness using secondary data. Fourth, this study represents one of the few that empirically tests agency theory and resource dependence theory in the IT governance and IT business value domain.

In addition to the research contributions, this study has several important practical implications for IT management practices. First, our results show that IT awareness helps reduce ITCWs. Organizations may use our findings to enhance IT awareness of the board of directors. Second, our results will guide boards and executives in making IT investment decisions as well as using IT to help create business value. Our study sheds light on the important role of IT awareness in obtaining competitive advantage. It will help organizations make decisions on the investment of IT. Third, firms may consider the IT experience and knowledge of the board of directors during the hiring process to ensure less ITCWs and better firm performance.

This paper is limited by the nature of the secondary data. For instance, there are limitations of the presence of unrecorded data and constraints of the data reporting format. The ITCWs are measured as binary variable. Future research may consider more fine-grained measures of ITCWs and explore the impact of IT awareness on the degree of ITCWs when the data reporting is standardized.

Another limitation of this study is that the data is based on two years' data due to the feasibility of the data collection process. While there are enough samples to run the analysis for the dataset, future study could include the most recent data to extend the analysis.

## REFERENCES

- Alreemy, Z., Chang, V., Walters, R., and Wills, G. (2016). Critical success factors (CSFs) for information technology governance (ITG). *International Journal of Information Management*, 36(6): 907–916.
- Andriole, S.J. (2009). Boards of directors and technology governance: The surprising state of the practice. *Communications of the AIS*, 24(22): 373–394.
- American Institute of Certified Public Accountants (AICPA) (2006). Understanding the entity and its environment and assessing the risks of material misstatement. Statement on Auditing Standards No.109. New York, NY: AICPA.
- Basu, A., and Jarnagin, C. (2008). How to tap IT's hidden potential. *Wall Street Journal*, March 10.
- Bharadwaj, A.S., Bharadwaj, S.G., and Konsynski, B.R. (1999). Information technology effects on firm performance as measured by Tobin's q. *Management Science*, 45(6): 1008-1024.
- Bharadwaj, A.S. (2000). A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly*, 24(1): 169-196.
- Beneish, M.D., Billings, M.B., and Hodder, L.D. (2008). Internal control weaknesses and information uncertainty. *The Accounting Review*, 83(3): 665-703.
- Boh, W.F., and Yellin, D. (2006). Using enterprise architecture standards in managing information technology. *Journal of Management Information Systems*, 23(3): 163-207.

- Bradley, R. V., Pratt, R. M., Byrd, T. A., & Simmons, L. L. (2011). The role of enterprise architecture in the quest for IT value. *MIS Quarterly Executive*, 10(2), 73-80.
- Brynjolfsson, E., and Hitt, L.M. (2000). Beyond computation: Information technology, organization transformation and business performance. *Journal of Economic Perspectives*, 14(4): 23-48.
- Carter, L., and Phillips, B., and Millington, P. (2012). The impact of information technology internal controls on firm performance. *Journal of Organizational and End User Computing*, 24(2): 39-49.
- Cereola, S.J., and Cereola, R.J. (2011). Breach of data at TJX: An instructional case used to study COSO and COBIT, with a focus on computer controls, data security, and privacy legislation. *Issues in Accounting Education*, 26(3): 521-545.
- Chen, Y., Smith, A.L., Cao, J., and Xia, W. (2014). Information technology capability, internal control effectiveness, and audit fees and delays. *Journal of Information Systems*, 28(2): 149-180.
- Chen, Y., and Zhu, J. (2004). Measuring information technology's indirect impact on firm performance. *Information Technology and Management*, 5(1): 9-22.
- Chi, M., Zhao, J., George, J.F., Li, Y., and Zhai, S. (2017). The influence of inter-firm IT governance strategies on relational performance: the moderation effect of information technology ambidexterity. *International Journal of Information Management*, 37(2): 43-53.
- Cram, W. A., Brohman, M. K., & Gallupe, R. B. (2014). Addressing the control challenges of the enterprise architecture process. *Journal of Information Systems*, 29(2), 161-182.
- Dehning, B., and Stratopoulos, T. (2002). DuPont analysis of an IT-enabled competitive advantage. *The International Journal of Accounting Information Systems*, 3(3): 165-176.
- Deloitte. The tech-intelligent board. New York, NY: Deloitte Touche Tohmatsu Limited, 2011.

- Devaraj, S., and Kohli, R. (2003). Performance impacts of information technology: Is actual usage the missing link? *Management Science*, 49(3): 273-289.
- Eisenhardt, K.M. (1985). Control: Organizational and economic approaches. *Management Science*, 31(2): 134-149.
- Eisenhardt, K.M. (1989). Agency theory - An assessment and review. *Academy of Management Review*, 14(1): 57-74.
- Foorthuis, R., Steenbergen, M., Brinkkemper, S., & Bruls, W. A. (2016). A theory building study of enterprise architecture practices and benefits. *Information Systems Frontiers*, 18(3), 541-564.
- Frost, R.B., and Choo, C.W. (2017). Revisiting the information audit: a systematic literature review and synthesis. *International Journal of Information Management*, 37(1): 1380-1390.
- Gujarati, D.N. (2003). Basic Econometrics, 4th ed. McGraw-Hill, NY.
- Hall, A.J. (2011). Information technology auditing, 3<sup>rd</sup> ed. South-Western: Cengage Learning.
- Hamdan, B.J. (2011). Examining the antecedents of Sarbanes-Oxley Section 404 IT control weaknesses: An empirical study. In: Proceedings of the International Conference on Information Systems. Shanghai, China.
- Hillman, A.J., and Dalziel, T. (2003). Boards of directors and firm performance: Integrating agency and resource dependence perspectives. *Academy of Management Review*, 28(3): 383-396.
- Huff, S.L., Maher, P.M., and Munro, M.C. (2006). Information technology and the board of directors: Is there an IT attention deficit? *MIS Quarterly Executive*, 5(2): 1-44.
- Jewer, J., and McKay, N.K. (2012). Antecedents and consequences of board IT governance: Institutional and strategic choice perspectives. *Journal of the Association for Information Systems*, 13(7): 581-617.
- John, K., and Senbet, L.W. (1998). Corporate governance and board effectiveness. *Journal of Banking and Finance*, 22(4): 371-403.

- Judge, W., and Zeithaml, C. (1992). Institutional and strategic choice perspectives on board involvement in the strategic decision process. *Academy of Management Journal*, 35(4): 766-794.
- Klein, A. (2002). Economic determinants of audit committee independence. *The Accounting Review*, 77(2): 435-452.
- Kohli, R., and Grover, V. (2008). Business value of IT: An essay on expanding research directions to keep up with the times. *Journal of the Association for Information Systems*, 9(1): 23-39.
- Kroll, M., Walters, B.A., and Wright, P. (2008). Board vigilance, director experience, and corporate outcomes. *Strategic Management Journal*, 29(4): 363-382.
- Kuhn, J.R., Ahuja, M., and Mueller, J. (2013). An examination of the relationship of IT control weakness to company financial performance and health. *International Journal of Accounting and Information Management*, 21(3): 227-240.
- Li, C., Lim, J.H., and Wang, Q. (2007). Internal and external influences on IT control governance. *International Journal of Accounting Information System*, 8(4): 225-239.
- Lim, J. H., Stratopoulos, T. C., & Wirjanto, T. S. (2013). Sustainability of a firm's reputation for information technology capability: The role of senior IT executives. *Journal of Management Information Systems*, 30(1): 57-95.
- Masli, A., Richardson, V. J., Watson, M. W., and Zmud, R. W. (2009). CEO, CFO & CIO engagement in information technology management: The disciplinary effects of Sarbanes-Oxley information technology material weaknesses. *Proceedings of the University of Waterloo Centre for Information Integrity and Information Systems Assurance*, (April 2009).
- Parent, M., and Reich, B.H. (2009). Governing information technology risk. *California Management Review*, 51(3): 134–152.
- Public Company Accounting Oversight Board (PCAOB) (2004). Auditing Standard No. 2 Internal Control. Retrieved June 30, 2010, from <http://www.pcaob.org>.

Public Company Accounting Oversight Board (PCAOB) (2007). Auditing Standard No.5 - An audit of internal control over financial reporting that is integrated with an audit of financial statements.

Public Company Accounting Oversight Board (PCAOB) (2010). Identifying and assessing risks of material misstatement, AS No. 12. Washington, DC: PCAOB.

Purnanandam, A.K., and Swaminathan, B. (2004). Are IPOs really underpriced? *The Review of Financial Studies*, 17(3): 811-848.

Rainer, K.R., Prince, B., and Cegielski, C. (2014). Introduction to Information Systems: Supporting and Transforming Business, 5<sup>th</sup> ed. John Wiley & Sons, Inc.

Ravichandra, T., Liu, Y., Han, S., and Hasan, I. (2009). Diversification and firm performance: Exploring the moderating effects of information technology spending. *Journal of Management Information Systems*, 25(4), 205-240.

Schmidt, C., & Buxmann, P. (2011). Outcomes and success factors of enterprise IT architecture management: empirical insight from the international financial services industry. *European Journal of Information Systems*, 20(2), 168-185.

Securities and Exchange Commission (SEC) (2003) Final rule: management's reports on internal control over financial reporting and certification of disclosure in exchange act periodic reports. Release Nos. 33-8238 (June 5), Washington, D.C. Available at: <http://www.sec.gov/rules/final/33-8238.htm>.

Shan, G.Y., and Troshani, I. (2014). Does XBRL benefit financial statement auditing? *Journal of Computer Information Systems*, 54(4): 11-21.

Shih, K.H. (2010). Risk indicators for computer systems assisted financial examination. *Journal of Computer Information Systems*, 50(4): 97-106.

Stoel, M.D., and Muhanna, W.A. (2011). IT internal control weaknesses and firm performance: An organizational liability lens. *International Journal of Accounting Information Systems*, 12(4): 280-304.

- Sundaramurthy, C., and Lewis, M. (2003). Control and collaboration: Paradoxes of governance. *Academy of Management Review*, 28(3): 397-415.
- Sung, T.K., and Gibson, D.V. (1998). Critical Successful Factors for Business Reengineering and Corporate Performance: The Case of Korean Corporations. *Technological Forecasting and Social Change*, 58(3): 297-311.
- Van der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H. (2010). The relation between EA effectiveness and stakeholder satisfaction. *Journal of Systems and Software*, 83(10), 1954-1969.
- Westby, J.R. (2012). Governance of enterprise security: CyLab 2012 report. Pittsburgh, PA: Carnegie Mellon CyLab.
- Yayla, A.A., and Hu, Q. (2014). The effect of board of directors' IT awareness on CIO compensation and firm performance. *Decision Sciences*, 45(3): 401-436.
- Zhang, P., Visinescu, L.L., Zhao, K., and Kumar, R. (2015). Using text mining analytics to understand IT internal control weaknesses. In *Workshop on E-Business*, 155-160, Spring, Cham.
- Zhang, P., Zhao, K., and Kumar, R. (2016). Impact of IT governance and IT capability on firm performance. *Information Systems Management*, 33(4): 357-373.
- Zhang, P., Zhao, K., and Kumar, R. (2018). The impact of firm characteristics and IT governance on IT material weaknesses. *Journal of Organizational and End User Computing*, 30(2): 88-111.