IT Governance Effectiveness and Its Influence on Innovation Product and Process

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IT governance effectiveness and its influence on innovation product and process

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***Abstract*—Information technology (IT) and innovation are topics that receive the attention among academics. However, the increasing and pervasive dependence on IT from organizations have raised a lot of concerns on the topic of IT governance (ITG). ITG and innovation do not have had the attention among academics. This study aims to examine the relationship among effective ITG, ITG relevant knowledge and how they influence innovation product and process. This study uses structural equation modeling (SEM) to evaluate 215 valid surveys that were collected from members of the respective local chapters located in Bogotá – Colombia of the following institutions: Information Systems Audit and Control Association (ISACA) and Project Management Institute (PMI). In addition, members of the Colombian computer science engineers association (ACIS) also participate answering our survey instrument. Our study found that ITG has positive and significant influence on innovation product and process. ITG relevant knowledge influences positively ITG especially when ITG experience is high, however, when the ITG experience is low, its effect is perceived as negative on innovation product and process.**

I. INTRODUCTION

Information technologies (IT) and innovation are topics that have received enough attention from the literature. Both terms are recognized by the public and private sectors around the world as drivers for improving public services in the case of governments [1] and as drivers for improving business performance by getting competitive advantages for firms in the private sector [2]. Tiwana and Kim [3] remark that there is a clear relationship between the two when they state that most of the firms use IT in their daily operations, but IT by itself doesn't create advantages, the real weapon is finding out how agile firms are when using IT to create innovations at all levels. For instance, the increasing use of IT in daily operations has raised a growing concern about firms' increasing and critical dependence on IT and how to deal with its increasing complexity. These concerns are rapidly spreading in public and private sectors. Besides, in the last decade, some corporate and significant businesses like Enron and WorldCom collapsed which pushed governments to enact new regulations about the accuracy of information in organizations [4].

Regulations like Sarbanes-Oxley (SOX) and BASEL in the United States and Switzerland respectively, have pushed organizations around the world to adopt some corporate management practices [5] that make it compulsory to have an oversight of business executives and check the accuracy of the information about IT projects, making them the only visible heads responsible for providing regulators with timely and trusted information [6].

Management practices created to deal with the increasing complexity of governing and managing IT are well-known as IT governance (ITG). ITG applies to all kinds of organizations (public or private) that use IT to support their business operations. However, ITG has two clear drawbacks. First, literature on the subject is still scarce and the few studies conducted on the subject only investigate which mechanisms improve ITG in organizations [7], and second, there is no clear definition of ITG. Mahy, Ouzzif [8] conducted a comprehensive literature review on the definition of ITG and found 26 definitions with a consensus among academicians and practitioners that IT governance is still an unclear concept.

Our study uses a mix of the most referenced definitions that is: IT Governance is a set of structured processes and relations that help businesses achieve their strategic objectives through IT use that maximizes returns on IT investments while balancing the risks that come out of IT operations [16, 19]. ITG is gaining attention of IT practitioners. For instance, [9] mention that ITG was ranked among the top three priorities among chief information officers (CIOs) worldwide.

Othman, Chan [10] argue that ITG practices can be seen as incremental and administrative innovations because it is a new role that represents significant and major changes not only at the structure, but also at the process level. They also highlight that there is a huge gap between developed and developing countries in terms of studies on ITG and add that most of the studies on ITG have been done in developed countries. In addition, there is no clear research stream in ITG. Most of the studies are descriptive and study the influence of some ITG frameworks like ITIL and COBIT, but there are few

quantitative studies that address ITG and how effective it is. Moreover, there are very few studies on ITG's effectiveness that address how ITG practices influences the effectiveness of ITG.

In addition, literature presents a disconnect between ITG and innovations. Innovations also have a drawback in their definition. Baregheh, Rowley [11] conducted a study researching innovations in different fields and collected 60 definitions. Our work uses the definition from OECD and the one used by [12] whose study is so one of the few academic works that research the link between ITG effectiveness and innovation. This definition views innovation as 'the perception of new or upgraded product or process or new business methodologies adopted by individual organizations.'

In the Colombian context, the government's initiatives are targeted at improving IT over the next few years. In fact, the Colombian government has established IT and innovation as priorities for national development, expecting to invest 1 percent of its gross domestic product (GDP) in IT by 2018 [13]. In addition, the national government has also promoted IT governance through initiatives like the national IT plan, Act 052 to ensure information security in financial companies in the public and private sector, and the adoption of best practices in the public sector like total quality management, project management methodologies and information security management.

There are very few studies that directly address ITG's effectiveness empirically. In fact, Preittigun, Chantatub [14] did a study comparing ITG research and found that among the 100 articles classified as suitable for their study less than 10 percent were empirical studies, the rest were conceptual papers. They also found that most of the research articles were from developing countries and they state that developed countries have regulations linked to ITG, whilst developing countries do not have these regulations.

With this horizon, our work tries to fill the gap not only in researches on ITG, but it is also the first empirical study that links ITG and innovations in the Colombian context.

ITG effectiveness is defined as the degree to which IT delivers appropriate services needed to support business operations and goals [15]. To achieve effective ITG, five objectives must be accomplished: 'Cost-effective use of IT, effective use of IT for growth, effective use of IT for asset utilization, effective use of IT for business flexibility, and Effective use of IT for compliance with legal and regulatory requirements.' The first four objectives were proposed by [16] and the fifth was proposed by [17].

In addition, our study examines ITG relevant knowledge represented by the perceptions that executives had about knowledge in ITG mechanisms. In consequence, two research questions are formulated:

a) What is the influence of ITG effectiveness on innovation?

b) What is the influence of ITG relevant knowledge on innovation?

The paper continues as follows. Section two reviews the literature that supports our study. Section three presents the research model and hypotheses. Section four describes the research methodology. Section five presents the results and discussion, and section six presents a summary with contributions, limitations, and future studies.

II. LITERATURE REVIEW

Adoption of ITG is particular and unique to each organization and it does not mean that mechanisms that work in one organization will work in other organizations [18]. [19] states that ITG is the responsibility of the board of directors and effective ITG performance is its direct responsibility [20]. In fact, lack of executive support in implementing effective ITG is viewed as a main obstacle in its effective implementation. This is because the strategic importance of ITG is underestimated by the board of directors [21]. In the case of innovations, Zona, Zattoni [22] state that the board of directors sets the strategic direction of an organization, emphasizing innovation and change and establishing the parameters for screening specific aspects of innovation projects.

[23] define management innovation as 'the invention and implementation of management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goal'. They also mention that the introduction of novelty practices produces organizational changes that are considered the management of innovations.

ITG and innovations have been considered strategic issues for organizations. Mohamed and Kaur Ap Gian Singh [24] believe that IT governance needs a strategic level commitment because it is a strategic issue that deals with how IT gives business value to organizations and Baregheh, Rowley [11] state that innovations are also strategic issues that organizations must promote to sustain their competitive positions. They add that organizations have to innovate if they have to respond to changes in customer behavior to capitalize on the opportunities that technology brings to the market so that they can sustain competitive advantages thanks to the role that innovation plays. Other studies like [25] state that innovation is a key driver that supports firms' competitive advantage by developing new product or services.

ITG is gaining attention and its importance is being recognized. In fact, Mahy, Ouzzif [8] state that with a pervasive and critical dependence on IT, ITG is not an option for organizations; it is a necessity that must be addressed and adopted and Simonsson, Johnson [20] add that every organization that deals with IT implicitly also addresses ITG.

Regulations like Corporate Law Economic Reform Program (CLERP 9) and SOX in the US are important drivers that have pushed the development, adoption and generalized acknowledgment of ITG worldwide by both practitioners and researchers [9, 26-29]. Regulations like SOX were enacted after significant business collapses like Enron and WorldCom

that pushed governments to enact regulations on the accuracy of information in organizations [4] making ITG compulsory for many organizations [30].

Failure or lack of ITG have also been mentioned recently. Raghupathi [6] gives two examples of lack of ITG. First, How a breach in VISA and American Express' security rules led to the loss of personal information about their users and second the long downtime in the Tokyo Stock Exchange's services leading to several hours of delay in financial transactions.

There is a consensus in literature that IT is used as a driver for developing innovations with strong support from the boards of directors and executive managements of organizations [31]. However, there is no link between ITG and innovation in literature. The only exception is the study of [12] in which they found that some developed ITG mechanisms effected product and process innovations differently. They also found that perceptions about good ITG mechanisms were increasing the level of product innovations, but they were less associated with process innovations. Surprisingly they also found a board's IT competence did not have a significant influence on innovations.

Some studies on ITG mention innovations indirectly. Othman, Chan [10] state that a CIO is relatively a new position or role within an organization that represents significant and major changes at the structure and process levels and this position could be viewed as an example of radical administrative innovations. They argue that ITG practices are incremental and administrative innovations. [32] emphasizes that administrative innovations deal with the allocation of resources, policies and rewards, while issues related to technology are addressed by technical innovations. [33] state that through their leadership CEOs and executives play an instrumental role in the introduction of new processes, practices and structures in organizations. These practices support the management on a daily basis and help bring about changes in the way in which the management performs [34]. Moreover, top management executives have the status and power to introduce organizational changes and most of these administrative innovations are implemented using a top-down approach because in many cases they are approved by the board members [32].

III. RESEARCH MODEL AND HYPOTHESES

The proposed research model is shown in Figure 1. ITG effectiveness and ITG relevant knowledge are hypothesized to evaluate their influence on innovation products and processes.

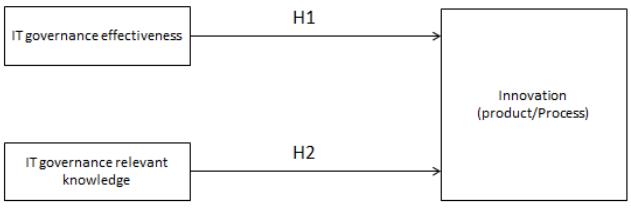

Fig. 1. Research framework

The study used the variable ITG experience to divide the dataset into two groups. The first group has data from organizations with more than 10 years of experience in adopting and implementing ITG practices and the second group has organizations with 10 or less years of experience in implementing ITG practices.

A. *IT governance's effectiveness (ITGEFF)*

Most firms use IT in their daily operations. But IT by itself does not create advantages, the real weapon is finding out how agile they are in using IT to create innovations at all levels [3]. However, the acquisition, deployment, and appropriate use of IT must be effective so that organizations can benefit from it [26]. Robinson also states that this effectiveness is provided by ITG. Buchwald, Urbach [15] state that the degree to which IT delivers appropriate services that are needed to support business operations and goals defines ITG effectiveness. To achieve effective ITG, five objectives must be accomplished: 'Cost-effective use of IT, effective use of IT for growth, effective use of IT for asset utilization, effective use of IT for business flexibility, and effective use of IT for compliance with legal and regulatory requirements.' The first four objectives were proposed by [16] and the fifth was proposed by [17].

However, there is intangible tension between ITG and the agility to foster innovations [35]. These authors mention that ITG proposes anticipation through well-designed plans while agility in for innovations promotes quick adaptation to dynamic and volatile environments. Therefore, the following hypothesis is proposed:

H1: The effectiveness in ITG influences innovations at product and process levels positively.

B. *IT governance relevant knowledge (ITGKNW)*

The executive management and board of directors' knowledge is critical for achieving ITG effectiveness. Some activities like the implementation of IT controls for compliance with regulations need strong support and knowledge among the top management because these activities are costly and difficult to operate [36]. ITGI [19] defines ITG knowledge as knowledge about ITG structures, ITG processes, and ITG relational mechanisms that the executive management has. Structures determine responsibilities and roles within business units that are in-charge of decision-making related to IT. Processes relate to the management of all procedures, policies and documentation about IT management and relational mechanisms are soft skills that create a proper environment for business and IT to reach common objectives. Therefore, the following hypothesis is proposed:

H2: ITG relevant knowledge influences innovations at product and process levels positively.

C. *IT governance experience (ITGEXP)*

How long ITG implementation takes to achieve effective results is a question that does not have a clear answer. Rau [37] emphasizes that it takes years to set policies and control results in ITG to achieve effectiveness. [38-40] share a common view that the timeline for ITG effectiveness is a long journey. Our study proposes that companies which have been implementing ITG for more than 10 years have high experience in ITG and companies that have been implementing ITG for 10 years or less have low experience.

D. Product and process innovations

[12] define product innovations as the development of a new good, product, or service or significant improved characteristics of an existing good, product or service in an organization. They say that process innovation occurs when a new process is introduced by an organization or when a process is upgrading making it more efficient and productive.

IV. Research Methodology

The data for this study was collected using through a survey instrument adopted from previous studies. Before delivering the survey to the target responders, we conducted an expert's review of the constructs with the aim of confirming the understanding of the questions. Email invitations were sent to three of the most significant associations in Colombia such as the ISACA (Information Systems and Audit Control Association, Bogotá – Chapter), PMI (Project Management Institute – Bogotá – Chapter), and the Colombian Association of Computer Science Engineers (ACIS – Asociación Colombiana de Ingenieros de Sistemas). [20, 41] argue that members from ISACA are IT experts that are permanently updated on ITG issues and they have the experience and professional qualifications that warranty the accuracy of their responses. Personal emails were also sent to computer science engineers and some education institutions that were suggested by the experts. The responders were IT experts with experience dealing with IT governance. We received 215 surveys with valid responses out of 908 or a 23.67 percent response rate.

All ethics guidelines were followed to assure that each responder of the survey participated voluntarily. The information gathered by our survey instrument will be maintained in absolute confidentially, assuring total anonymity of the responders. The data collected was used only for achieving the objectives of the research. Tables I, II, and III show the sample characteristics of the data.

TABLE I. Responder's profile frequency

Responder's profile	Frequency	Percentage
CIO	29	13.5
Professor/Teacher	9	4.2
IT Practitioner	56	26.0
IT Supervisor	9	4.2
IT Manager	42	19.5
IT Director	34	15.8
Vice-President	6	2.8
CEO	30	14.0
Total	215	100

TABLE II. Type of organization by frequency

Organization's profile	Frequency	Percentage
Commercial Public	9	4.2
Not Profit Organization	15	7.0
Government	41	19.1
Private	150	69.8
Total	215	100

TABLE III. Type of industry by frequency

Industry's profile	Frequency	Percentage
Agriculture, forestry and fishing	2	0.9
Mining and quarrying	3	1.4
Manufacturing	6	2.8
Electricity, gas, steam and air conditioning supply	2	0.9
Water supply: sewerage, waste management and remediation activities	3	1.4
Construction	10	4.7
Wholesale and retail trade; repair of motor vehicles and motorcycles	3	1.4
Transportation and storage	2	0.9
Information and communication	45	20.9
Financial and insurance activities	12	5.6
Professional, scientific and technical activities	25	11.6
Administrative and support services activities	11	5.1
Public administration and defense; compulsory social security	8	3.7
Education	30	14.0
Human health and social work activities	11	5.1
Arts, entertainment and recreation	1	0.5
Other Services (Except Public Administration)	40	18.6
Activities of extraterritorial organizations and bodies	1	0.5
Total	215	100

A. Study variables

The variables in this study were adopted from previous studies. It used two dependent variables: Product innovation and process innovation. The independent variables are: ITG effectiveness and ITG knowledge. ITG experience was used to divide the dataset into two groups. The first group has organizations with high ITGEXP and the second has organizations with low ITGEXP. With the exception of ITG experience, all variables were measured using a 5-point Likert scale. Table IV gives a brief definitions of the variables, the acronyms and the source from which the variables were extracted.

TABLE IV. Definitions and source of variable

Variable	Definition	Source
IT Governance Effectiveness (ITGEFF)	ITG effectiveness is defined as the degree by which IT delivers the appropriate services to support business operations and goals [15].	[16, 17]
ITG relevant knowledge (ITGRKN)	ITGI [19] defines ITG relevant knowledge as the knowledge about ITG structures, ITG processes, and ITG relational mechanisms that	[42]

	executive management has	
Product innovation (INPD)	Héroux and Fortin [12] said that product innovation occurs when a firm develops or introduces new products, or products with important updates that enhance their functionality.	[43]
Process innovation (INPR)	Héroux and Fortin [12] said that process innovation occurs when a process receive important upgrades making it more efficient and productive.	[43]
ITG experience (ITGEXP)	Dummy variable. We proposed that companies which started ITG implementation within a period longer than 10 years have high experience in ITG and companies with 10 years or less have low experience.	Not apply

V. Results and Discussion

In order to analyze the data, we perform the descriptive statistics of mean, standard deviation, Cronbach's alpha and composite reliability (CR) for variables in this study. 215 observations were available for this study. Cronbach's alpha and CR tests were conducted to check the reliability of the data. According to [28], CR is preferable because it is based on item loadings. The CR and Cronbach's alpha tests show that all scores were above the minimum level of 0.7. Table V presents the result of our descriptive statistics.

TABLE V. Descriptive Statistics and Reliability Measures

Item Code	Alpha	CR	Mean	Std.Dev
ITG importance (ITGIMP)	0.915	0.918		
ITGIMP_1			3.820	0.970
ITGIMP_2			3.900	0.883
ITGIMP_3			3.780	0.888
ITGIMP_4			3.830	0.882
ITGIMP_5			4.050	0.825
ITG Successful (ITGSUC)	0.917	0.918		
ITGSUC_1			3.450	0.894
ITGSUC_2			3.550	0.851
ITGSUC_3			3.470	0.911
ITGSUC_4			3.520	0.880
ITGSUC_5			3.770	0.837
Product innovation (INPD)	0.947	0.948		
INPD_1			3.430	1.189
INPD_2			3.490	1.080
INPD_3			3.430	1.189
INPD_4			3.290	1.160
Process innovation (INPR)	0.939	0.940		
INPR_1			3.600	0.989
INPR_2			3.520	1.036
INPR_3			3.63	1.014
ITG relevant knowledge (ITGRKN)	0.947	0.948		
ITGRKN_1			3.480	1.027
ITGRKN_2			3.470	1.027
ITGRKN_3			3.460	0.994

An exploratory factor analysis (EFA) uses maximum likelihood for the extraction method with promax rotation to extract the unique factors that support each construct from our survey instrument. Academicians recommended two test to examine the suitability and adequacy of the data collected: 'Kaiser-Meyer-Olkin KMO measure of sampling adequacy and Bartlett's test of sphericity' that check if the data is appropriate for EFA [44]. The KMO test score was 0.896. The Bartlett's test scores were X^2=4319.45; df=190; and p=0.000 for chi-square, degrees of freedom and p-value respectively which indicate that our data was appropriated for performing EFA. EFA obtained the pattern matrix in which five factors were extracted. Table VI shows that all values in the pattern matrix are above 0.5. As suggested by [45] these are under acceptable limits. The five factors extracted were named ITGIMP, ITGSUC, INPD, INPR and ITGRKN. The five factors explained a total of 77.36% of the variance.

TABLE VI. Pattern Matrix of Factors Extracted

Factor Extracted	Factor loading	Factor				
		1	*2*	*3*	*4*	*5*
IT governance importance (ITGIMP)	ITGIMP_1			0.756		
	ITGIMP_2			1.007		
	ITGIMP_3			0.777		
	ITGIMP_4			0.742		
	ITGIMP_5			0.616		
IT governance successful (ITGSUC)	ITGSUC_1		0.814			
	ITGSUC_2		0.850			
	ITGSUC_3		0.854			
	ITGSUC_4		0.849			
	ITGSUC_5		0.633			
Innovation product (INPD)	INPD_1	0.941				
	INPD_2	0.885				
	INPD_3	0.909				
	INPD_4	0.835				
Innovation process (INPR)	INPR_1					0.826
	INPR_2					0.910
	INPR_3					0.859
IT governance relevant knowledge (ITGRKN)	ITGRKN_1				0.883	
	ITGRKN_2				0.960	
	ITGRKN_3				0.902	

In our confirmatory factor analysis (CFA), the study checked the data reliability once again using the test of CR because the variable ITGEFF comes out from the combination of ITGIMP and ITGSUC into a second order construct. CR is used to check the reliability based on item loadings as it is suggested by [28]. The scores obtained for CR test are above the minimum level of 0.7, which indicate the reliability of our data. Discriminant validity was checked getting the square root

values of all items with values greater than any inter-factor correlation in the matrix and by the average variance extracted (AVE) showing that all values were greater than 0.5. Table VII shows the validity of the measures for the data set.

TABLE VII. MODEL VALIDITY MEASURES

	AVE	MSV	MaxR(H)	1	2	3	4	5
1	0.694	0.569	0.933	**0.833**				
2	0.820	0.511	0.949	0.472	**0.906**			
3	0.694	0.569	0.930	0.754	0.540	**0.833**		
4	0.858	0.258	0.952	0.508	0.381	0.466	**0.926**	
5	0.838	0.511	0.941	0.575	0.715	0.580	0.404	**0.916**

1-ITGSUC; 2-INPD; 3-ITGIMP; 4-ITGRKN; 5-INPR.

The study used the structural equation model to check the hypotheses stated earlier. Table VIII shows the summary of the model fit and figure 2 gives the SEM path analysis in which the solid lines indicate causal paths while the dotted lines give the insignificant paths and also gives the summary of the significance level and standardized regression weights of our models' path.

TABLE VIII. MODEL FIT MEASURES

Measure	Estimate	Threshold
CMIN	736.658	
DF	320	
CMIN/DF	2.302	Between 1 and 3
CFI	0.904	> 0.95
SRMR	0.067	< 0.08
RMSEA	0.078	< 0.06

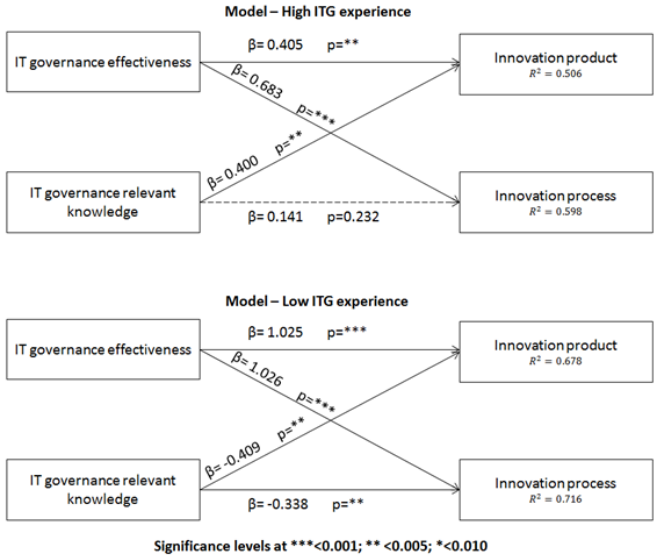

Fig. 2. Results from both groups

The results indicate that R^2 for both the groups was between 50.6 and 71.6 percent. As we expected in the first group with a high ITG experience ITGEFF had a positive and significant influence on INPD and INPR with standardized estimates of 0.405, p=.002 and .683, p< .001, We thus accept hypothesis H1. These results suggest that as long as ITG delivers the five objectives proposed by [16, 17], perceptions about its influence on product and process innovations is positive. As expected, ITGRKN had a positive and significant influence on INPD (0.400, p=0.002), but surprisingly it did not have any significant influence on INPR, accepting hypothesis H2 partially. This result can be explained as changes in policies, procedures and documentation that these organizations need to carry out to implement ITG.

As expected, in the second group with low ITG experience ITGEFF had positive and significant influence on INPD and INPR with standardized estimates of 1.025, p<0.001 and 1.026, p< 0.001) accepting hypothesis H1. As in the first model perceptions about its influence on product and process innovations were positive. ITGRKN had a significant, but negative influence on INPD and INPR with standardized estimates of -0.409; p=0.002 and -0.338' p=0.008), rejecting hypothesis H2.

VI. SUMMARY, IMPLICATIONS, CONTRIBUTION, LIMITATIONS, AND FUTURE STUDIES

Summary

The objective of this study was examining the influence effect of ITG effectiveness and ITG relevant knowledge on innovations in products and processes and also the differences between these relationships when the ITG experience is high or low. As was expected, the results showed that ITG effectiveness was seen to positively and significantly influence innovations at the product and process levels. This influence was slightly higher on process innovations for both the groups. These results are a consequence of the introduction, adoption and deployment of ITG practices. Heroux and Fortin [12] found that ITG exerted a positive influence on innovations. These are unique studies that relate ITG to innovations and in both studies the perceived influence of ITG on innovations is clear.

This study measures IT governance effectiveness using the most accepted approach proposed by [16] and complemented later by [17] in which they measure IT governance effectiveness base on the achievements of the following objectives: 'Cost-effective use of IT, effective use of IT for growth, effective use of IT for asset utilization, effective use of IT for business flexibility, and Effective use of IT for compliance with legal and regulatory requirements.' The variable ITG relevant knowledge was based on the approach of [42] measuring the level of knowledge that executive management has about ITG mechanisms. The innovation product and process were measured using the approach of [43].

The sample data used by this study was collected via surveys. Email invitations were sent to three most significant associations in Colombia such as the ISACA (Information Systems and Audit Control Association, Bogotá – Chapter), PMI (Project Management Institute – Bogotá – Chapter), and the Colombian Association of Computer Science Engineers (ACIS – Asociación Colombiana de Ingenieros de Sistemas). Other personal emails were sent to computer science engineers, which were suggested by the experts and some academic institutions. The responders were IT experts with experience dealing with IT governance. We received 215 surveys with valid responses out of 908 or a 23.67 percent response rate. Our study found that IT governance effectiveness impact positively and significant innovation product and process.

Contribution

This study contributes to ITG research as it introduces the first quantitative approach that measures ITG effectiveness and its relationship with innovations products and processes. The approach uses the five objectives that must be achieved by organizations in their IT use. These objectives summarize what organizations are looking for in terms of IT. So far, only one study has addressed ITG and innovations. This, however, did not evaluate the effectiveness of ITG. Instead, it measures ITG based on the perceptions about some individual ITG mechanisms.

Our study also introduces new variables like ITG relevant knowledge and ITG experience. These variables make our study more robust as they take into account the executive management's knowledge of ITG and the experience that organizations have in implementing ITG. Besides, previous studies on ITG include data samples collected from specific economic sectors. The dataset in our study includes organizations from different economic sectors; the organizations are of different sizes including SME's and large enterprises.

Implication

In practical terms the results of our study show that perceptions about an effective ITG positively impact innovations at product and process levels. The top management's knowledge of ITG mechanisms is perceived as a positive contributor to innovations only when there is enough ITG experience. This result shows that practitioners need to understand that ITG is not just a matter of knowing some theoretical concepts that executives understand; there also has to be enough experience in issues related to ITG for IT practitioners' knowledge to be a relevant contributor in fostering innovations by using IT. The results suggest that organizations that want to enhance their innovations should look for the ITG mechanisms needed to improve the role that IT plays in their organizations. IT can leverage innovation activities only if it delivers proper services to support business operations. As many academicians suggest, ITG effectiveness is a long journey and organizations should start adopting ITG practices so that they can figure out how ITG will enhance the benefits that IT could bring to the organizations in the long run.

Limitations

ITG involves all members from an organization. Even though in our sample we had different IT specialist responders, we suggest to include other members from organizations, especially personnel from the front-line that on the daily basis face the pros and cons of any decision related to IT. Another limitation we faced is that the data for this study was gathered only through surveys covering only organizations from Colombia avoiding to generalize our results to other countries.

Future studies

In order to get more accurate measures of ITG effectiveness and its influence on innovations, other approach to measure innovation product and processes should be evaluated. We suggest, evaluating the ITG effectiveness based on how the objectives are matched with organizational goals about innovations to have more robust measures about how ITG effectiveness is among organizations and how it influences innovations. Other proposal is to extend this study to different countries overseas to get an idea about how ITG effectiveness influences innovations in other countries.

REFERENCES

[1] R. M. Walker, "Innovation type and diffusion: An empirical analysis of local government," Public administration, vol. 84, pp. 311-335, 2006.

[2] V. C. Nguyen and N. T. Chau, "Research framework for the impact of total quality management on competitive advantage: the mediating role of innovation performance," Review of International Business and Strategy, pp. 00-00, 2017.

[3] A. Tiwana and S. K. Kim, "Discriminating IT Governance," Information Systems Research, vol. 26, pp. 656-674, 2015.

[4] A. T. Chatfield and T. Coleman, "Promises and successful practice in IT governance: a survey of Australian senior IT managers," 2011.

[5] P. H. d. S. Bermejo, A. O. Tonelli, and A. L. Zambalde, "Developing IT Governance in Brazilian Public Organizations," International Business Research, vol. 7, 2014.

[6] W. Raghupathi, "Corporate governance of IT: A framework for development," Communications of the ACM, vol. 50, pp. 94-99, 2007.

[7] S. Ali and P. Green, "Effective information technology governance mechanisms in public sectors: an australian case," PACIS 2006 Proceedings, p. 99, 2006.

[8] Y. Mahy, M. Ouzzif, and H. Bouragba, "Toward a Shared View of IT Governance," Intenational Journal of Innovation, Management and Technology, vol. 7, 2016.

[9] S. Ali and P. Green, "Determinants of effective information technology governance: A study of IT intensity," in Proceedings of the International IT Governance Conference, Auckland, New Zealand, 2005.

[10] M. F. I. Othman, T. Chan, E. Foo, K. J. Nelson, and G. T. Timbrell, "Barriers to information technology governance adoption: a preliminary empirical investigation," in Proceedings of 15th International Business Information Management Association Conference, 2011, pp. 1771-1787.

[11] A. Baregheh, J. Rowley, and S. Sambrook, "Towards a multidisciplinary definition of innovation," Management decision, vol. 47, pp. 1323-1339, 2009.

[12] S. Héroux and A. Fortin, "The Influence of IT Governance, IT Competence and IT-Business Alignment on Innovation," Cahier de recherche, p. 04, 2016.

[13] Colciencias. (2016, 08/03/2017). Colombia le sigue apostando a la inversión privada en Ciencia, Tecnología e Innovación. Available: http://www.colciencias.gov.co/sala_de_prensa/colombia-le-sigue-apostando-la-inversion-privada-en-ciencia-tecnologia-e-innovacion

[14] A. Preittigun, W. Chantatub, and S. Vatanasakdakul, "A Comparison between IT governance research and concepts in COBIT 5," International Journal of Research in Management & Technology, vol. 2, pp. 581-590, 2012.

[15] A. Buchwald, N. Urbach, and F. Ahlemann, "Understanding IT governance success and its impact: Results from an interview study," in Proceedings Of The 21st European Conference On Information Systems (ECIS), 2013.

[16] P. Weill and J. W. Ross, IT governance: How top performers manage IT decision rights for superior results: Harvard Business Press, 2004.

[17] P. L. Bowen, M.-Y. D. Cheung, and F. H. Rohde, "Enhancing IT governance practices: A model and case study of an organization's efforts," International Journal of Accounting Information Systems, vol. 8, pp. 191-221, 2007.

[18] E. M. Luciano, G. C. Wiedenhöft, and M. A. M. Moron, "What is in or out of a particular field of knowledge? Reflections on IT Governance Studies," in Proceedings of the 7th CONF-IRM–International Conference on Information Resources Management, 2015.

[19] ITGI. (2003, 27/03/2017). Board Briefing on IT Governance. Available: https://www.oecd.org/site/ictworkshops/year/2006/37599342.pdf

[20] M. Simonsson, P. Johnson, and M. Ekstedt, "The Effect of IT Governance Maturity on IT Governance Performance," Information Systems Management, vol. 27, pp. 10-24, 2010.

[21] E. Boritz and J.-H. Lim, "Impact of top management's IT knowledge and IT governance mechanisms on financial performance," ICIS 2007 Proceedings, p. 88, 2007.

[22] F. Zona, A. Zattoni, and A. Minichilli, "A contingency model of boards of directors and firm innovation: The moderating role of firm size," British Journal of Management, vol. 24, pp. 299-315, 2013.

[23] J. Birkinshaw, G. Hamel, and M. J. Mol, "Management innovation," Academy of management Review, vol. 33, pp. 825-845, 2008.

[24] N. Mohamed and J. Kaur Ap Gian Singh, "A conceptual framework for information technology governance effectiveness in private organizations," Information Management & Computer Security, vol. 20, pp. 88-106, 2012.

[25] E. Calik, F. Calisir, and B. Cetinguc, "A Scale Development for Innovation Capability Measurement," Journal of Advanced Management Science Vol, vol. 5, 2017.

[26] N. Robinson, "IT excellence starts with governance," Journal of Investment Compliance, vol. 6, pp. 45-49, 2005.

[27] S. De Haes and W. Van Grembergen, "An Exploratory Study into IT Governance Implementations and its Impact on Business/IT Alignment," Information Systems Management, vol. 26, pp. 123-137, 2009.

[28] G. L. Lunardi, A. C. G. Maçada, and J. L. Becker, "IT Governance Effectiveness and Its Antecedents: An Empirical Examination in Brazilian Firms," in System Sciences (HICSS), 2014 47th Hawaii International Conference on, 2014, pp. 4376-4385.

[29] S. Buckby, P. Best, and J. Stewart, "The current state of information technology governance literature," Information Science Reference (IGI Global), 2008.

[30] G. Hardy, "Using IT governance and COBIT to deliver value with IT and respond to legal, regulatory and compliance challenges," Information Security Technical Report, vol. 11, pp. 55-61, 2006.

[31] S. Hérouxa and A. Fortin, "Diversity and IT competence of Board of directors and executive management and innovation-based business strategy," Cahier de recherche, p. 09, 2013.

[32] R. L. Daft, "A dual-core model of organizational innovation," Academy of management journal, vol. 21, pp. 193-210, 1978.

[33] I. G. Vaccaro, J. J. Jansen, F. A. Van Den Bosch, and H. W. Volberda, "Management innovation and leadership: The moderating role of organizational size," Journal of Management Studies, vol. 49, pp. 28-51, 2012.

[34] G. Hamel, "The why, what, and how of management innovation," Harvard business review, vol. 84, p. 72, 2006.

[35] E. S. Couto, M. F. C. Lopes, and R. D. Sousa, "Can IS/IT Governance Contribute for Business Agility?," Procedia Computer Science, vol. 64, pp. 1099-1106, 2015.

[36] J. E. Boritz and J.-H. Lim, "IT control weaknesses, IT governance and firm performance," 2008.

[37] K. G. Rau, "Effective Governance of IT: Design Objectives, Roles, and Relationships," Information Systems Management, vol. 21, pp. 35-42, 2004.

[38] B. Gu, L. Xue, and G. Ray, "IT governance and IT investment performance: an empirical analysis," 2008.

[39] A. Kearney, "The 7 Habits of Highly Effective IT Governance: Powerful Lessons in Transforming Business and Information Technology," ed, 2008.

[40] D. McGilvray, "Data governance: a necessity in an integrated information world," Information Management, vol. 16, p. 24, 2006.

[41] C. Ferguson, P. Green, R. Vaswani, and G. H. Wu, "Determinants of Effective Information Technology Governance," International Journal of Auditing, vol. 17, pp. 75-99, 2013.

[42] S. Ali, P. Green, and A. Robb, "Measuring Top Management's IT Governance Knowledge Absorptive Capacity," Journal of Information Systems, vol. 27, pp. 137-155, 2013.

[43] D. I. Prajogo and P. K. Ahmed, "Relationships between innovation stimulus, innovation capacity, and innovation performance," R&D Management, vol. 36, pp. 499-515, 2006.

[44] B. Williams, A. Onsman, and T. Brown, "Exploratory factor analysis: A five-step guide for novices," Australasian Journal of Paramedicine, vol. 8, 2010.

[45] H. F. Kaiser, "An index of factorial simplicity," Psychometrika, vol. 39, pp. 31-36, 1974.