Model for Information Technology Governance (GTI) in a University Environment

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Abstract. The university makes use of information technology resources for an effective management of its tasks, as well as for generating information for the interested parties, among which are the accreditation and control bodies. The problem is that most of the time when computers are used, the information is not of high quality due to the lack of appropriate practices for using information technologies (IT) efficiently. This occurs because there are no effective practices for executing a proper Information Technologies Governance. The purpose of this work is to generate an Information Technology Governance (GTI) model within an organization.

Keywords. Information technologies governance, structures, processes, relational mechanisms, information quality.

1 Introduction

In Ecuador, the new Organic Law of Higher Education (LOES), which is consistent with the new constitutional principles established in the 2008 Supreme Charter contemplates, the "quality principle"; universities have been subjected to a series of compliances, internal structural changes for generating continuous improvement, evaluations, process improvements, personnel reengineering, data processing, evidence presentation, data archiving, and so on. During this time period, there is greater dependence on IT and it is necessary to have an adequate IT Governance to support the organization's strategy.

The Evaluation, Accreditation and Quality Assurance Council for Higher Education in Ecuador (CEAACES) applies the evaluation process to the universities in three phases: First, design and construction of an "evaluation model"; second, collection and verification of the information presented by the universities, and third the "diagnosis of consistency, coherence and analysis of information". If they find inconsistencies in the information, the parties involved are requested to clarify and include the corresponding justification and support. The entire process is executed through computer media and all the evidence is digital.

The data produced by the university come from different internal sources such as: computer systems, electronic files, databases, scanned reports, and digitized internal communications. The IT area efficiency in this environment is a critical factor that should be the answer to an effective IT Governance that minimizes the circumstances in which the information is inconsistent, duplicated, not of absolute reliability, inefficient and ineffectively produced [1].

The situation described here is present in a great number of universities in Ecuador, including those which are co-financed (between the state and the private sector) and belong to Zone 6 (provinces of Azuay, Cañar and Morona Santiago), more specifically, the Catholic University of Cuenca (UCACUE) and the Salesiana Polytechnic University (UPS), organizations where the modeling is being tested.

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For authors like Sigalés [2] and Jhon [3], not all the experiences on incorporating IT to the university activity have provided the expected results; the recommendation for is that they should also attend to the strategic levels and not only to the middle and lower levels in an organization [4], so that they become collaborators and executors of key solutions; the accomplishment of an effective IT governance is essential to achieve an alignment between the ITs and the organization [5].

The research issue lies in building the design of the Information Technology Governance Model for the university sector, which relates the variables involved (structures, processes, relational mechanisms, and domains), in order to ensure adequate levels of IT governance maturity and to meet the quality requirements of the information presented through IT means to the interested parties.

The article contains: The analysis of relevant literature on IT Governance, the operationalization of variables, hypotheses, the proposed model description, the research methodology details, results, conclusions, and future research. It makes use of the structural equations (MEE) modeling technique applied in technology management research works [6], specifically the one supported in the variance denominated: PLS (Partial Least Squares) through the use of the Smart PLS 3.1.9 software package.

2 Literature Review

In developed countries, IT Governance is a subject of detailed research, especially in the financial, industrial, commercial, and telecommunications sectors; and, to a lesser extent, in the educational sector. One of the biggest frustrations at the university management level is accepting the fact that most of the frameworks have been developed to support the improvement of for-profit organizations; so leaders of organizations such as universities need to forge different IT governance models to support their strategies, location, and their regulatory framework [7].

According to Tanuwijaya and Sarno [8], it is necessary for the university to consider the strategic importance of IT resources aimed to improve education quality. The results of the study, sponsored by the Educause Center for applied Research (ECAR); on university IT maturity levels, which involved more than 400 IT managers from universities around the world, state that: 1.6% does not yet possess an IT governance practice; 28.8% are at an initial level; 29.7% are in a replicable state; 23.7% in a defined state; 10.5% are in a managed state while 5.7% is in the optimized range [9].

Therefore an efficient IT Governance is required at the university to guarantee appropriate maturity levels [10]. At the international level, several universities have implemented their own IT governance models. One of the first efforts to design a university-wide model was proposed in the United Kingdom by the Joint Information Systems Committee (JISC), which was created to be used in different types of organizations whether large, small, public, or private [11].

This model is based on five different perspectives: governance, organization, administration, resources and services.

In Ibero-America, Spanish universities are the first to propose several models of IT governance, such as: the UNiTIL model, which incorporates the analysis of the actual situation of information technologies in the organization [12].

Jaume I University's model designs and implements a technological framework aimed at creating an organizational culture that enables: the organization of human talent, the rational use of IT resources and the participation of the actors involved, an appropriate organizational structure, to count on mechanisms for formalizing the relationships between services and the participating actors, to adopt IT project management methodologies, to use COBIT[1] framework, and the management of information systems, [13].

[1] COBIT, Control Objectives for Information and Related Technologies. It is a set of best practices for IT management.

Table 1. IT governance maturity model

Level	Name	Description
0	Does not exist	They are not in the least applied.
1	Initial	They are ad-hoc and disorganized.
2	Repeatable	They follow a regular pattern.
3	Defined	It is standardized.
4	Managed	It is integrated into the university and is monitored.
5	Optimised	It has been depurated to a best practice level.

Table 1. Dimensions of the variable quality of information, which the research assumes

Dimension	Definition	Reference
Effectiveness	The information is relevant and pertinent to the organization's processes, it is timely delivered, in a consistent, correct and useful manner.	[40]
Efficiency	The information is generated with optimization or resources.	[41]
Confidentiality	The information is sensitive and is protected from unauthorized disclosure.	[42]
Integrity	The information is complete, accurate, and valid according to the organization.	[43]
Availability	The information is available when required.	[44]
Compliance	Deals with complying with the laws, regulations and contractual arrangements.	[38]
Reliability	Appropriate information is provided so that, managerial levels run the organization on its basis.	[41]

Table 3. Question vs hypothesis

Derived Questions	Specific Hypothesis
How do structures influence the Information Technology Governance maturity at the university?	**Hypotheses 1 (H1):** The structures influence the Information Technology Governance maturity at the university.
How do processes influence the Information Technology Governance maturity at the university?	**Hypothesis 2 (H2):** The processes influence the Information Technology Governance maturity at the university.
How do relational mechanisms influence the Information Technology Governance' maturity at the university?	**Hypothesis 3 (H3):** Relational mechanisms influence the Information Technology Governance maturity at the university.
What is the influence of the domains on the Information Technology Governance's maturity at the university?	**Hypothesis 4 (H4):** The domains influence the Information Technology Governance maturity at the university.
How does the Information Technology Governance maturity level influence the university to meet the information quality requirements?	**Hypothesis 5 (H5):** The maturity level of Information Technology Governance influences information quality.
How does information quality influence the university to fulfill the information needs of the interest groups?	**Hypothesis 6 (H6):** Information quality at the university influences the fulfillment of the information needs of the interest groups.

Another contribution is the MGTIU model known as GTI4U, proposed by the Conference of Rectors of Spanish Universities (CRUE), which is grounded on three layers: the upper layer formed by the principles of the ISO 38500 standard, the middle one constituted by the IT objectives and the

basic one agglutinated by the IT processes which are specific to each university. This model is based on previous models [14] and the added value is the incorporation of the following governance principles to the organization: to lead, to evaluate and to monitor; it adopts the ISO 38500 references for the design of its own good practice catalog, complying with the six fundamental principles: performance, responsibility, compliance, human talent, strategy and acquisition [15].

In the Latin American context, no references have been found of research projects implemented to suggest a framework for IT university governance [16]. What educational institutions have done is to implement their own practices or assume, in part, the existing frameworks generated for other sectors as in the case of COBIT. According to Brown and Grant [17], the culture in its different dimensions has influence on IT governance, that is why Zhong, Vatanasakdakul and Aoun [18], state that IT Governance frameworks need to be adapted to the culture of each region and country, only then it is feasible to particularize the IT Governance framework for the regional university.

The concept underlying the research defines that IT governance involves the determination and implementation of mechanisms (processes, structures and relational mechanisms) that enable for human talent of both the organization and the ITs to carry out their responsibilities, so that they can add value to IT investments [19], ensuring that IT decisions are aligned with the organization's objectives [20], and that they allow to take advantage of Information, capitalize opportunities, generate competitive advantages and increase profits [21].

According to Peterson [22], IT governance is an integration of tactics and strategies, he suggests that it must be developed alongside a combination of: structures, processes and relational mechanisms, De Haes and Grembergen [23], affirm that depending on multiple contingencies the optimal juncture will be different in each organization. Each of these components is explored below.

According to Peterson [24], the structures include organizational units, roles, and responsibilities for IT decision-making. As said by De Haes & Van Grembergen [25], Luftman & Brier [26], the most feasible structures for implementing IT governance are: the IT organizational structure; the IT roles and responsibilities; the IT Strategic Committee; the IT Steering Committee; the CIO[2] in the Strategic Committee; and the CIO reporting to the CEO[3], [27]. This list of 6 structures is the one considered for dimensioning the respective variable in the research.

The processes referring to strategic and IT monitoring decisions, have been identified according to several authors: Strategic planning of information technologies [28]; The Balanced Command Board (BSC) according to Parisa, Lazar and Shengnan [29]; Service Level Agreements (SLAs), [30]; Economic information (portfolio management); Best practices such as COBIT.

Relational mechanisms are related to the understanding of the relationship between the IT and the organization; they consider shared knowledge a two-way communication: participation and collaboration among the organization and IT areas.

They are key and a priority for the alignment of the organization and IT as long as the structures and appropriate processes are present especially in the initial stages of implementation of the IT Governance [31].

They include job rotation; cross training; knowledge administration on IT Governance; Administrators of the IT-organization relationship; senior administrator and IT; Informal sessions between the organization and IT; IT leadership; and Internal corporate communications focused on IT.

On the other hand, IT Governance domains enable organizations to be more competitive, they maintain and expand the organization’s strategies and objectives, help to achieve strategic IT alignment, and increase profitability, revenue, growth and Innovation [32].

[2] Chief Information Officer, plays a leading role in IT promotion

[3] Chief Executive Officer, manages the strategic treatment of IT within the organization.

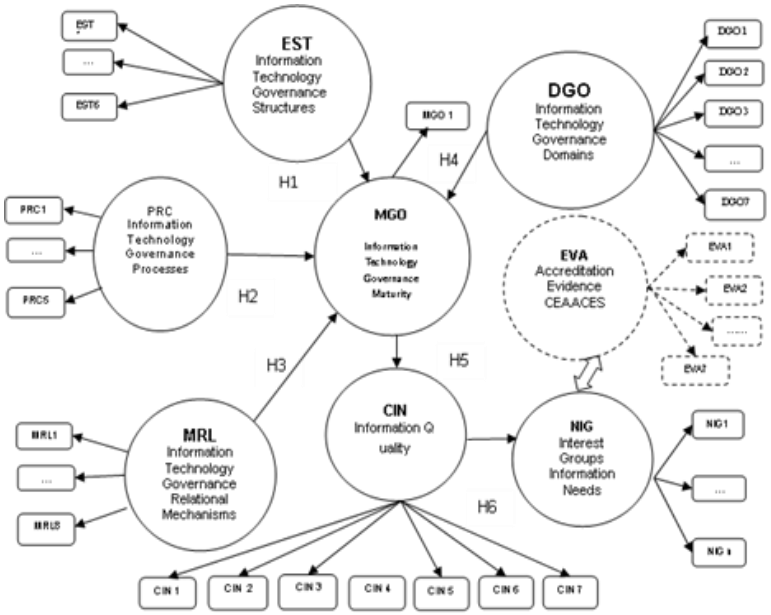

Fig. 1. Proposed Research Model, its constructs and indicators

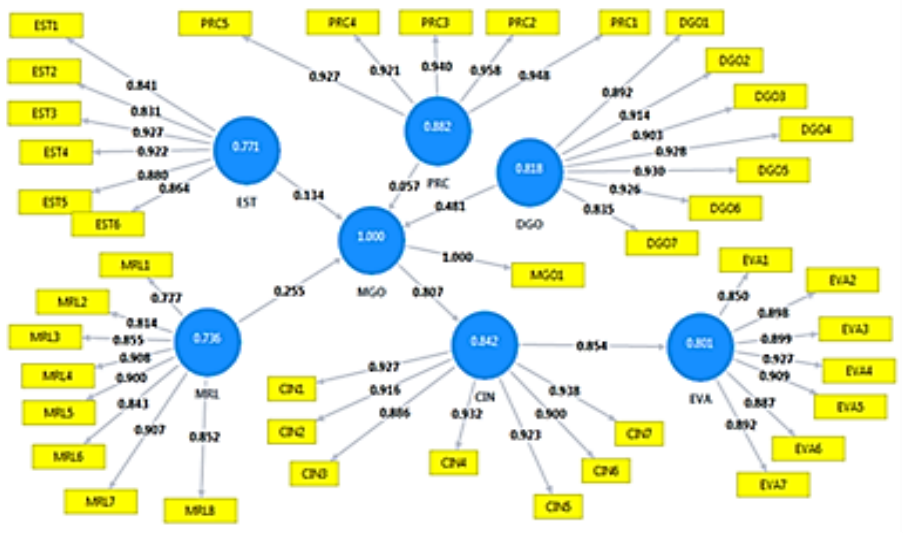

Fig. 2. Model Results in Smart Pls 3.1.9

Hence, the following should be done: manage risk [33], increase value [34], and maintain control of programs and activities [17]. Therefore, for the Information Technology Governance Institute, the IT Governance domains must be focused on a framework including strategic alignment, value delivery, resource management, risk management, and performance measurement [28].

Table 4. Variables Operationalization

Construct	ID	INDICATOR (Questions' text)
EST Information Technology Governance Structures	EST1	IT decision-making?
	EST2	IT Roles and responsibilities?
	EST3	The IT Strategic Committee and its role?
	EST4	The IT Governing Board and its role?
	EST5	The IT Manager (CIO, head, manager) is part of the IT Strategic Committee?
	EST6	The IT Manager (CIO, chief, manager) reports on his/her activities?
PRC Information Technology Governance Processes	PRC1	IT Strategic planning?
	PRC2	IT Indicators?
	PRC3	Agreements on the level of service provided by Its?
	PRC4	Economic control of information technologies?
	PRC5	Standard processes of practice improvements (COBIT)?
MRL Information Technology Governance Relational mechanisms	MRL1	IT staff rotation in the organization?
	MRL2	University personnel training on IT?
	MRL3	knowledge transfer on IT Governance in the organization through different means?
	MRL4	Relationship among the different areas and the IT area?
	MRL5	The university administration and CIO work together?
	MRL6	Informal mechanisms for work sessions between the organization and the IT area?
	MRL7	IT manager (CIO, boss, manager) technology leadership?
	MRL8	IT policies on IT services for all sectors?
MGO, IT Governance Maturity	MGO1	IT Governance maturity level in the organization?
DGO Information Technology Governance Domains	DGO1	IT alignment with the organization's strategy?
	DGO2	IT provides of strategic, financial, technological and social value to the organization?
	DGO3	IT value is measured by the quality of the information they provide?
	DGO4	IT risks are managed in concordance with the organization?
	DGO5	Infrastructure, human talent, applications and information management?
	DGO6	IT performance measurements?
	DGO7	The manager monitors and reports about IT performance?
CIN Quality of Information	CIN1	The information generated through IT use is relevant and appropriate to the organization processes, It is timely delivered in a consistent, correct and useful manner?
	CIN2	The information generated through IT use is prepared while optimizing resources?
	CIN3	Sensitive information generated through IT use is protected from unauthorized disclosure?
	CIN4	The information generated through IT use is complete, accurate, and valid according to the organization?
	CIN5	The information generated through IT use is available when required by the organization's users?
	CIN6	The information generated through the use of IT complies with the laws, regulations, and contractual agreements to which the organization is subjected to, in the internal and external fields?
	CIN7	Appropriate information is provided through the use of IT, so that the organization is managed based on this information?
EVA CEAACES Accreditation Evidence	EVA1	The information generated, through the use of IT with respect to the academic criterion, contains information on the teacher's education, working time, remunerative and administrative aspects?
	EVA2	The information generated by using IT regarding the academic efficiency criterion, contains data of admission, initial undergraduate rate and the final efficiency data of the student?
	EVA3	The information generated by using IT concerning the research criterion, includes planning data, regional research, and the production of peer-reviewed articles and books?
	EVA4	The information generated by using IT with regard to the organization criterion, includes data on monitoring graduates and bonding with the community?
	EVA5	The information generated by using IT regarding the organization criterion, contains data on ethics and responsibility, transparency and accountability, as well as budget quality?
	EVA6	The information generated by using IT of the organization criterion, has data on the regulation of the academic system and affirmative action?
	EVA7	The information generated by using information technologies of the infrastructure criterion contains library data, information technology data, teaching facilities data, classrooms' quality data, and data on areas for the well-being of students?

Regarding IT Governance maturity, the IT Governance Institute (ITGI) model of maturity is taken as a source, and it is synthesized in Table 1. It includes the 6 established levels of maturity which go from 0 to 5 [35].Source: Henderson, Venkatraman, and Oldach [36] The information quality in the organization is In regard to the need of stakeholder information, Nascimiento and

Table 5. The Measurement Model Reliability Results

Parameter	Values obtained from the model
Individual reliability of the item	All weights are above 0.707, however for Mendoza, Segovia and Rositas [47], indicators with weights higher than 0.5 are acceptable. The weights of the indicators as can be seen in figure 2 are higher than 0.5.
Reliability of each construct	The Cronbach values of the constructs for alpha exceed the 0.7 value, which gives validity to the construct, as shown in table 6. In the compound reliability analysis, all model constructs present values which are higher than 0.7; this confirms the Internal consistency of all constructs, and then the indicators (observable variables) are validated in order to verify whether they are actually measuring the constructs (latent variables).
Convergent validity	The Average Variance Extracted (AVE) is used, the values exceed the minimum recommended value which is 0.5. This criterion is fulfilled, see table 6. Afterwards, the indicators intended to measure a construct are validated to verify that they truly measure it.
Discriminant validity	The square root values of AVE are shown in Table 6, and the correlations among the constructs are shown in Table 7. For the model, the requirement that the square root of AVE is greater than the correlation among them, is not 100% met, for example, it is lower in the EST construct, see Table 7. Thus it cannot be concluded that the model meets the discriminant validity criterion, that the latent variables are clearly differentiated. However, in order to strengthen the discriminant validity analysis, cross-load checking is performed, see Table 8, where each indicator has a correlation with its own latent variable, rather than with the others, this implies that it is not necessary to readjust the model.

Weschenfelde [39] affirm that it varies from one individual to another and from group to group, it can or cannot be transformed in-demand. The authors themselves define it as the information deficiency that an individual or organization must fulfill in order to carry out a personal update or to make decisions depending on the situation.

3 Methodology

3.1 Problem Statement

Based on the theoretical components, the research questions are presented, and the hypotheses to be demonstrated are set forth, as indicated in Table 3.

3.2 Proposed Model

The model specified in Figure 1 is generated from the stated hypotheses, which consists of seven constructs (circular representation) and 41 indicators (rectangular representation). The constructs are the following: Information Technology Governance structures (EST), Information Technology Governance processes (PRC), Information Technology Governance Relational Mechanisms (MRLs), Information Technology Governance domains (DGO), Information Technology Governance maturity (MGO), *Information* Quality (CI), and the *Interest Groups Information Needs* (NIG). When applying the structural model to the universities which are object of the research, the variable "NIG, need for Information of Interest Groups" has become "EVA, Evidence of Accreditation by CEAACES", with seven indicators. Each indicator is linked to its respective construct and has its own coding.

The corresponding operation of variables is carried out from the proposed hypotheses and the theoretical references, as shown in table 4. On regard to the application, this step is previous to the elaboration of the measurement instrument.

3.3 Sampling Frame

The Catholic University of Cuenca (UCACUE), founded in 1970 in the city of Cuenca in Ecuador, has university extensions in Quito, Azogues, Cañar, San Pablo de La Troncal, and Macas; It offers tertiary education careers in the fields of Social sciences, Engineering, Health Sciences, Business and Economics and is characterized by providing high quality christian education.

Table 6. Cronbach's alpha values, composite reliability, AVE, AVE's square root for each construct

Construct	Cronbach's alpha	Composite Reliability	AVE	AVE's Square root
CIN	0.969	0.974	0.842	0.917
DGO	0.963	0.969	0.818	0.904
EST	0.940	0.953	0.771	0.878
EVA	0.959	0.966	0.801	0.895
MGO	1.000	1.000	1.000	1.000
MRL	0.948	0.957	0.736	0.858
PRC	0.966	0.974	0.882	0.943

Table 7. Correlations among constructs. Fornell-Larcker Criterion

	CIN	DGO	EST	EVA	MGO	MRL	PRC
CIN	0.917						
DGO	0.885	0.904					
EST	0.784	0.818	0.878				
EVA	0.854	0.808	0.710	0.895			
MGO	0.807	0.864	0.785	0.720	1.000		
MRL	0.839	0.886	0.808	0.741	0.837	0.858	
PRC	0.780	0.838	0.900	0.705	0.792	0.831	0.939

Currently, it has approximately 10,000 students and 700 teachers; the administrative staff is made up of 300 people.

The Salesian Polytechnic University (UPS), founded in 1994, has three branches: the main branch is located in the city of Cuenca and the other ones in the cities of Quito and Guayaquil. It has 1,000 teachers and an average of 17,000 students, with an academic offer distributed in graduate and postgraduate careers, in the areas of Engineering, social Sciences, Education and Veterinary.

To determine the sample, who the instruments are going to be applied to, the "triple criteria" technique is used, applying: non-probabilistic, intentional sampling (snowball) and through judgment or convenience; so, the participation of different types of informants, stakeholders or interested parties is expected.

With the aim of being more rigorous with the number of informants, the characteristics of the proposed model (41 indicators, eight constructs, zero is the maximum number of indicators for a latent variable of formative nature, four is the maximum number of paths in the structural model) is taken as reference.

According to "PLS modeling", the model sample size is 40 because the maximum number of paths in the structural part is 4 (arrows pointing to a construct), in this case, the EST, PRC, MRL, and DGO constructs point to MGO construct. In addition, "power analysis" is considered, which in the Social Sciences does not accept values lower than 80% [45], therefore, in a total of 40 cases, 40 + 32 = 72 cases are required to reach 80% of power, which are enough to test the model.

3.4 Information Collection Tool

To collect field information, a structured questionnaire with 41 questions organized in the following 8 sections:

Table 8. Cross loading

	CIN	DGO	EST	EVA	MGO	MRL	PRC
CIN1	0.927	0.838	0.762	0.765	0.750	0.809	0.736
CIN2	0.916	0.830	0.745	0.764	0.785	0.816	0.730
CIN3	0.886	0.792	0.713	0.749	0.733	0.770	0.741
CIN4	0.932	0.804	0.696	0.775	0.721	0.742	0.697
CIN5	0.923	0.793	0.697	0.788	0.710	0.734	0.691
CIN6	0.900	0.791	0.694	0.828	0.732	0.751	0.711
CIN7	0.938	0.831	0.726	0.813	0.752	0.764	0.706
DGO1	0.800	0.892	0.747	0.722	0.795	0.838	0.753
DGO2	0.828	0.914	0.730	0.749	0.765	0.808	0.743
DGO3	0.773	0.903	0.724	0.686	0.759	0.761	0.721
DGO4	0.819	0.928	0.756	0.758	0.785	0.806	0.785
DGO5	0.828	0.930	0.724	0.766	0.773	0.807	0.760
DGO6	0.812	0.926	0.751	0.752	0.790	0.823	0.783
DGO7	0.736	0.835	0.741	0.675	0.796	0.761	0.753
EST1	0.701	0.709	0.841	0.628	0.678	0.720	0.742
EST2	0.712	0.698	0.831	0.650	0.665	0.688	0.721
EST3	0.680	0.730	0.927	0.624	0.725	0.715	0.851
EST4	0.682	0.717	0.922	0.606	0.699	0.703	0.842
EST5	0.653	0.707	0.880	0.612	0.671	0.680	0.795
EST6	0.705	0.749	0.864	0.625	0.694	0.752	0.784
EVA1	0.770	0.729	0.631	0.850	0.618	0.637	0.599
EVA2	0.771	0.738	0.674	0.898	0.677	0.697	0.672
EVA3	0.755	0.745	0.651	0.899	0.668	0.661	0.656
EVA4	0.795	0.749	0.674	0.927	0.691	0.711	0.673
EVA5	0.755	0.703	0.629	0.909	0.618	0.630	0.626
EVA6	0.726	0.668	0.573	0.887	0.600	0.634	0.579
EVA7	0.776	0.724	0.613	0.892	0.635	0.666	0.605
MGO1	0.807	0.864	0.785	0.720	1.000	0.837	0.792
MRL1	0.614	0.646	0.598	0.554	0.600	0.777	0.628
MRL2	0.659	0.702	0.595	0.599	0.677	0.814	0.617
MRL3	0.695	0.755	0.691	0.637	0.702	0.855	0.714
MRL4	0.761	0.810	0.764	0.665	0.758	0.908	0.749
MRL5	0.804	0.823	0.773	0.678	0.786	0.900	0.768
MRL6	0.668	0.731	0.671	0.624	0.692	0.843	0.712
MRL7	0.784	0.817	0.750	0.662	0.785	0.907	0.785
MRL8	0.750	0.780	0.686	0.658	0.721	0.852	0.716
PRC1	0.746	0.796	0.865	0.682	0.758	0.808	0.948
PRC2	0.753	0.815	0.843	0.680	0.779	0.810	0.958
PRC3	0.722	0.779	0.843	0.648	0.746	0.761	0.940
PRC4	0.704	0.756	0.836	0.642	0.693	0.755	0.921
PRC5	0.737	0.786	0.839	0.657	0.739	0.766	0.927

Table 9. Structural Model Results

Parameter	Values obtained from the model
R^2 index	The predictive power measure of the model for dependent latent variables is obtained with the R^2 index, these show moderate and substantial values and are greater than 0.1, which ratifies the predictive characteristic of the model. The adjusted R^2 values, validate the adequate predictive power of the model, as shown in table 10.
Effect f^2	It measures the impact of a latent variable on a dependent construct; the model presents values that are not in the permitted range (values of 0.02, 0.15 and 0.35 are allowed) as shown in table 11.
Standardized *path* coefficients β	There are two values that do not exceed the minimum of 0.2, this is why from the structural point of view, for the case of the universities being analyzed, the conditions of the model are not being fulfilled, as it can be seen in table 12.
Bootstrapping analysis	Bootstrap also determines the standard error calculation of the parameters and the student's T values. In this field, the indicators for which the Student T is greater than 1.96, are considered significant. However, in certain constructs there are values below 1.96. Table 13 shows the relationships among constructs, it includes the standardized constants, the standard error, of the Student's T, the p- values, the relationships' significance, and the acceptance or rejection of the hypothesis.

General information, IT Governance structures, IT Governance processes, IT Governance relational mechanisms, IT Governance domains, IT Governance maturity, information quality, and evidence of accreditation by CEAACES. The answers evaluation scales vary from 0 to 5 and follow the IT governance maturity model pattern adopted in the present investigation; this form of evaluation makes reference to the method applied by the researchers Dahlberg and Lahdelma [46] in their work "IT Governance Maturity and Outsourcing Degree: an Exploratory Study".

4 Results

The questionnaire was implemented by using GoogleDocs and was socialized though the internet; during the process of collecting information, from the time when the corresponding authorizations were requested, until the time when its application took place between June and October 2016, 253 surveys were collected.

The model is tested in two phases: In the first place, the validity and reliability of the reflective measurement model, where the measurement of theoretical concepts correctness through the observed variables, are analyzed. See table 5. In the Second place, the evaluation of the structural model takes place based on the weight and the relationships magnitude. See table 9.

4.1 Discussion of Results and Implications

In the GTI model, the parameters that validate the measurement model are met, thus the reflective value of the indicators is reliable, which implies that the instrument used is statistically valid and reliable [48]; additionally, the indicators contribute significantly to the latent variables, that is to say, that each indicator is correlated with its own latent variable rather than with others.

When referring to the model structure, four of the six hypotheses (hypotheses three, four, five, and six) are statistically sustained; hypotheses one and two are rejected because they lack statistical support.

The model is highly predictable, since GTI has predicting relevance of the exogenous constructs over the endogenous ones, in other words, we can predict:

Table 10. R^2 of the latent dependent variables

	R^2	Adjusted R^2
CIN	0.652	0.650
EVA	0.730	0.728
MGO	0.779	0.775

Table 11. f^2 of the dependent latent variables

	CIN	DGO	EST	EVA	MGO	MRL	PRC
CIN				2.697			
DGO					0.185		
EST					0.014		
EVA							
MGO	1.872						
MRL					0.055		
PRC					0.002		

Table 12. Standardized path coefficients

	CIN	DGO	EST	EVA	MGO	MRL	PRC
CIN				0.854			
DGO					0.481		
EST					0.134		
EVA							
MGO	0.807						
MRL					0.255		
PRC					0.057		

- The "Information Technologies Governance Maturity (MGO)" construct, based on the following constructs: "Information Technologies Governance structure (EST)", "Information Technologies Governance processes (PRC)", "Information Technologies Governance Domains (DGO)", "Information Technology Governance Relational Mechanisms (MRL)".
- The "Quality of Information (CIN)" construct, based on the “Information Technologies Governance Maturity (MGO)" construct.
- The "Need for Stakeholder Information (NIG)" construct, based on the "Quality of Information (CIN)" construct.

With regard to hypotheses one and two, no significant relationship between the structures and processes with the IT governance maturity was found, the results contrast the findings of Teo, Manaf and Fong Choong [49] in the sense that IT governance requires adequate structures and processes to motivate initiatives for its development. In order to understand the reason why the constructs, structures and processes were not related to the IT Governance maturity, possible reasons are described:

- The respondents’ perception of the structures and processes concepts, or the inadequate interpretation of it, since 11.33% of respondents report that they do not exist at the university.
- 45.1% of respondents have less than five years working at the university and have not received the necessary information on IT Governance structures and processes.

Results validating what has been stated by Teo, Manaf and Fong [50] in their research about IT users, where it is stablished that low perception levels of IT governance practices in the organization are the result of poor socialization and internal training.

According to the literature it is acknowledged that depending on multiple contingencies, the optimal juncture among structures, processes and relational IT mechanisms will be different for each organization [51]. Therefore, it may be possible that the transposition of Anglo-Saxon models present difficulties to their implementation in the regional university environments, which would have to be validated with a new research.

Hypothesis three is accepted, in which the relational mechanisms influence IT governance maturity, they reaffirm the findings of Souza Bermejo et al [52], in the sense that relational mechanisms are the central axis for IT efficiency and consequently of the organization.

If GTI model were applied to another range or another group of institutions, the quantitative results of the model would be different and it may occur that all hypotheses are fully supported; this would have to be validated with new research.

The fact that the maturity of Information Technology Governance shows a positive relationship and a strong impact on the quality of

Table 13. Relationships among constructs

Hypothesis Relationship between constructs	β	Standard Error	t - student	p values	Level	Acceptance or rejection
H1:EST -> MGO	0.134	0.087	1.535	0.125	Nonsignificant	Rejected
H2:PRC -> MGO	0.057	0.080	0.715	0.475	Nonsignificant	Rejected
H3:MRL -> MGO	0.255	0.093	2.729	0.007	**	Accepted
H4:DGO -> MGO	0.481	0.095	5.081	0.000	***	Accepted
H5 MGO -> CIN	0.807	0.026	30.817	0.000	***	Accepted
H6: CIN -> EVA	0.854	0.020	42.518	0.000	***	Accepted

****** p<0.001; ** p< 0.01; * p< 0.05.***

the information in the organization reinforces the importance of having exploited these variables. For Torres, Torres & Rojas [53] it is a priority for the organization to improve and evaluate the quality of its information, since the institution per se its information, and its quality is a faithful reflection of the administration [54]; Information is a key resource for the organization and from the moment it is created until the technology is destroyed, it plays an important role. In the literature, no references were found to study the relationship of these two variables, so there is a contribution to the theory.

Carrying out research in the context of Latin American universities is validated as a contribution to their efficient development. For Yanosky & McCredie [55] as well as for Yanosky & Borrenson [9], there are few universities in the world that have in practice raised awareness of the importance of IT governance university-wise.

The domains of Information Technologies Governance, which use the GTI model are the following: "Strategic Alignment of the Institution with Information Technologies", "Delivery of IT value", "IT Risk Management", “IT resources management”, and "IT performance management", are statistically supported with hypothesis 4, and coincide with the domains validated by the AlAgha model [56], except for the "IT Governance Development" domain that the GTI model does not considers.

In regard to Latin American universities, the study by Musse & Brodbeck [57] on the level of maturity of IT Governance domains and processes that belong to the COBIT framework is cited, it was executed with the participation of 130 universities from Argentina, Brazil, Chile, Colombia, Ecuador, El Salvador, Guatemala, Paraguay, Peru, Uruguay, and Venezuela. The zero-to-five maturity level for COBIT domains at these universities is 3.1 for IT Governance until 2014.

When compared to results achieved in research where IT governance maturity reaches a score of 2.75 over five, it is acknowledged that the co-financed university of Zone 6 in Ecuador has an IT Governance maturity level that is below the average for the Latin American university.

5 Conclusion

The research carried out in the present work validates that the main objective has been fulfilled to suggest an Information Technology Governance (GTI) model, generated on the basis of domains, maturity, structures, processes and relational mechanisms that allow to meet the requirements of information quality in order to meet the needs of the interest groups at the university.

GTI model construction is the extension to theoretical bases already tested on IT Governance, such as those contemplated in the model proposed by De Haes & Van Grembergen [19], from where the variable structures, processes, relational mechanisms and its Influence on IT governance, are assumed; it

transfers from the AlAgha model [58] the notion that IT governance maturity is affected by the domains of information technologies; it considers the ontologies of quality, compliance, and security of the Institute of Governance of 2005 for information quality and it considers the IT governance maturity model of the same institute. Supporting the statements by Coen & Kelly [59], which indicate that a good part of the bases of IT governance frameworks of commercial organizations are valid for the university.

The resulting GTI model from this research responds to the necessity to support the fundamental role that information technologies play in all organizational fields today. This work does not respond to the political conjuncture of the current governance in Ecuador; it is rather the answer to support the imminent necessity of Ecuadorian society to provide a high-quality system of higher education. Several investigative processes currently being carried out in Ecuador proceed in this fashion, which have been leveraged as a result, with the power of current public policies aimed at supporting research so that its expansion is useful in the Ecuadorian environment.

Through IT Governance it is imperative that ITs aggregate "strategic" value, one of these means is for information to become useful knowledge for decision-making. This is necessary so that the organization does not consider ITs as a mere operational or management tool, but rather as a strategic element, IT governance is more than an agile administration, validating the importance of participation at the managerial level in this context according to Turel and Bart [60].

6 Future Research

In the investigation, the analyzed entities (two co-financed universities of Zone 6 of the Republic of Ecuador) are one of several alternatives, so it is possible to apply the model to a larger sample of universities, either public, private or rom a different locality, so that results can be obtained in order to compare them with the practical environment already analyzed.

The GTI model can be applied to institutional settings of a different nature, not only to higher education settings. It is feasible to use the variability of the *information requirement of the interest groups* construct, for this purpose. However, to validate what has been indicated, it will be necessary to enter a new investigative process.

For future research it would also be feasible to include additional variables in the GTI model particular to the institution's inner structure, such as: *organizational culture or the management of innovation and knowledge*.

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