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.
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 framework, and the management of information systems, [13].

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

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

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

<table>
<thead>
<tr>
<th>Derived Questions</th>
<th>Specific Hypothosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do structures influence the Information Technology Governance maturity at the university?</td>
<td>Hypotheses 1 (H1): The structures influence the Information Technology Governance maturity at the university.</td>
</tr>
<tr>
<td>How do processes influence the Information Technology Governance maturity at the university?</td>
<td>Hypothesis 2 (H2): The processes influence the Information Technology Governance maturity at the university.</td>
</tr>
<tr>
<td>How do relational mechanisms influence the Information Technology Governance maturity at the university?</td>
<td>Hypothesis 3 (H3): Relational mechanisms influence the Information Technology Governance maturity at the university.</td>
</tr>
<tr>
<td>What is the influence of the domains on the Information Technology Governance’s maturity at the university?</td>
<td>Hypothesis 4 (H4): The domains influence the Information Technology Governance maturity at the university.</td>
</tr>
<tr>
<td>How does the Information Technology Governance maturity level influence the university to meet the information quality requirements?</td>
<td>Hypothesis 5 (H5): The maturity level of Information Technology Governance influences information quality.</td>
</tr>
<tr>
<td>How does information quality influence the university to fulfill the information needs of the interest groups?</td>
<td>Hypothesis 6 (H6): Information quality at the university influences the fulfillment of the information needs of the interest groups.</td>
</tr>
</tbody>
</table>
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 in the Strategic Committee; and the CIO reporting to the CEO3. [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].

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

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

<table>
<thead>
<tr>
<th>Construct</th>
<th>ID</th>
<th>INDICATOR (Questions’ text)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EST</td>
<td>EST1</td>
<td>IT decision-making?</td>
</tr>
<tr>
<td></td>
<td>EST2</td>
<td>IT Roles and responsibilities?</td>
</tr>
<tr>
<td></td>
<td>EST3</td>
<td>The IT Strategic Committee and its role?</td>
</tr>
<tr>
<td></td>
<td>EST4</td>
<td>The IT Governing Board and its role?</td>
</tr>
<tr>
<td></td>
<td>EST5</td>
<td>The IT Manager (CIO, head, manager) is part of the IT Strategic Committee?</td>
</tr>
<tr>
<td></td>
<td>EST6</td>
<td>The IT Manager (CIO, chief, manager) reports on his/her activities?</td>
</tr>
<tr>
<td>PRC</td>
<td>PRC1</td>
<td>IT Strategic planning?</td>
</tr>
<tr>
<td></td>
<td>PRC2</td>
<td>IT Indicators?</td>
</tr>
<tr>
<td></td>
<td>PRC3</td>
<td>Agreements on the level of service provided by its?</td>
</tr>
<tr>
<td></td>
<td>PRC4</td>
<td>Economic control of information technologies?</td>
</tr>
<tr>
<td></td>
<td>PRC5</td>
<td>Standard processes of practice improvements (COBIT)?</td>
</tr>
<tr>
<td>MRL</td>
<td>MRL1</td>
<td>IT staff rotation in the organization?</td>
</tr>
<tr>
<td></td>
<td>MRL2</td>
<td>University personnel training on IT?</td>
</tr>
<tr>
<td></td>
<td>MRL3</td>
<td>Knowledge transfer on IT Governance in the organization through different means?</td>
</tr>
<tr>
<td></td>
<td>MRL4</td>
<td>Relationship among the different areas and the IT area?</td>
</tr>
<tr>
<td></td>
<td>MRL5</td>
<td>The university administration and CIO work together?</td>
</tr>
<tr>
<td></td>
<td>MRL6</td>
<td>Informal mechanisms for work sessions between the organization and the IT area?</td>
</tr>
<tr>
<td></td>
<td>MRL7</td>
<td>IT manager (CIO, boss, manager) technology leadership?</td>
</tr>
<tr>
<td></td>
<td>MRL8</td>
<td>IT policies on IT services for all sectors?</td>
</tr>
<tr>
<td>MGO, IT Governance Maturity</td>
<td>MGO1</td>
<td>IT Governance maturity level in the organization?</td>
</tr>
<tr>
<td>DGO</td>
<td>DGO1</td>
<td>IT alignment with the organization’s strategy?</td>
</tr>
<tr>
<td></td>
<td>DGO2</td>
<td>IT provides of strategic, financial, technological and social value to the organization?</td>
</tr>
<tr>
<td></td>
<td>DGO3</td>
<td>IT value is measured by the quality of the information they provide?</td>
</tr>
<tr>
<td></td>
<td>DGO4</td>
<td>IT risks are managed in concordance with the organization?</td>
</tr>
<tr>
<td></td>
<td>DGO5</td>
<td>Infrastructure, human talent, applications and information management?</td>
</tr>
<tr>
<td></td>
<td>DGO6</td>
<td>IT performance measurements?</td>
</tr>
<tr>
<td></td>
<td>DGO7</td>
<td>The manager monitors and reports about IT performance?</td>
</tr>
<tr>
<td>CIN</td>
<td>CIN1</td>
<td>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?</td>
</tr>
<tr>
<td></td>
<td>CIN2</td>
<td>The information generated through IT use is prepared while optimizing resources?</td>
</tr>
<tr>
<td></td>
<td>CIN3</td>
<td>Sensitive information generated through IT use is protected from unauthorized disclosure?</td>
</tr>
<tr>
<td></td>
<td>CIN4</td>
<td>The information generated through IT use is complete, accurate, and valid according to the organization?</td>
</tr>
<tr>
<td></td>
<td>CIN5</td>
<td>The information generated through IT use is available when required by the organization’s users?</td>
</tr>
<tr>
<td></td>
<td>CIN6</td>
<td>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?</td>
</tr>
<tr>
<td></td>
<td>CIN7</td>
<td>Appropriate information is provided through the use of IT, so that the organization is managed based on this information?</td>
</tr>
<tr>
<td>EVA</td>
<td>EVA1</td>
<td>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?</td>
</tr>
<tr>
<td></td>
<td>EVA2</td>
<td>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?</td>
</tr>
<tr>
<td></td>
<td>EVA3</td>
<td>The information generated by using IT concerning the research criterion, includes planning data, regional research, and the production of peer-reviewed articles and books?</td>
</tr>
<tr>
<td></td>
<td>EVA4</td>
<td>The information generated by using IT with regard to the organization criterion, includes data on monitoring graduates and bonding with the community?</td>
</tr>
<tr>
<td></td>
<td>EVA5</td>
<td>The information generated by using IT regarding the organization criterion, contains data on ethics and responsibility, transparency and accountability, as well as budget quality?</td>
</tr>
<tr>
<td></td>
<td>EVA6</td>
<td>The information generated by using IT of the organization criterion, has data on economic control of information technologies?</td>
</tr>
<tr>
<td></td>
<td>EVA7</td>
<td>The information generated by using IT of the organization criterion, contains data on agreements on the level of service provided by its?</td>
</tr>
</tbody>
</table>

Table 4. Variables Operationalization
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 (DOG), 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.
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 6. Cronbach’s alpha values, composite reliability, AVE, AVE’s square root for each construct

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
<th>AVE’s Square root</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIN</td>
<td>0.969</td>
<td>0.974</td>
<td>0.842</td>
<td>0.917</td>
</tr>
<tr>
<td>DGO</td>
<td>0.963</td>
<td>0.969</td>
<td>0.818</td>
<td>0.904</td>
</tr>
<tr>
<td>EST</td>
<td>0.940</td>
<td>0.953</td>
<td>0.771</td>
<td>0.878</td>
</tr>
<tr>
<td>EVA</td>
<td>0.959</td>
<td>0.966</td>
<td>0.801</td>
<td>0.895</td>
</tr>
<tr>
<td>MGO</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>MRL</td>
<td>0.948</td>
<td>0.957</td>
<td>0.736</td>
<td>0.858</td>
</tr>
<tr>
<td>PRC</td>
<td>0.966</td>
<td>0.974</td>
<td>0.882</td>
<td>0.943</td>
</tr>
</tbody>
</table>

#### Table 7. Correlations among constructs. Fornell-Larcker Criterion

<table>
<thead>
<tr>
<th></th>
<th>CIN</th>
<th>DGO</th>
<th>EST</th>
<th>EVA</th>
<th>MGO</th>
<th>MRL</th>
<th>PRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIN</td>
<td>0.917</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DGO</td>
<td>0.885</td>
<td>0.904</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EST</td>
<td>0.784</td>
<td>0.818</td>
<td>0.878</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVA</td>
<td>0.854</td>
<td>0.808</td>
<td>0.710</td>
<td>0.895</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGO</td>
<td>0.807</td>
<td>0.864</td>
<td>0.785</td>
<td>0.720</td>
<td>1.000</td>
<td></td>
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</tr>
<tr>
<td>MRL</td>
<td>0.839</td>
<td>0.886</td>
<td>0.808</td>
<td>0.741</td>
<td>0.837</td>
<td>0.858</td>
<td></td>
</tr>
<tr>
<td>PRC</td>
<td>0.780</td>
<td>0.838</td>
<td>0.900</td>
<td>0.705</td>
<td>0.792</td>
<td>0.831</td>
<td>0.939</td>
</tr>
</tbody>
</table>
Table 8. Cross loading

<table>
<thead>
<tr>
<th></th>
<th>CIN</th>
<th>DGO</th>
<th>EST</th>
<th>EVA</th>
<th>MGO</th>
<th>MRL</th>
<th>PRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIN1</td>
<td>0.927</td>
<td>0.838</td>
<td>0.762</td>
<td>0.765</td>
<td>0.750</td>
<td>0.809</td>
<td>0.736</td>
</tr>
<tr>
<td>CIN2</td>
<td>0.916</td>
<td>0.830</td>
<td>0.745</td>
<td>0.764</td>
<td>0.785</td>
<td>0.816</td>
<td>0.730</td>
</tr>
<tr>
<td>CIN3</td>
<td>0.886</td>
<td>0.792</td>
<td>0.713</td>
<td>0.749</td>
<td>0.733</td>
<td>0.770</td>
<td>0.741</td>
</tr>
<tr>
<td>CIN4</td>
<td>0.932</td>
<td>0.804</td>
<td>0.696</td>
<td>0.775</td>
<td>0.721</td>
<td>0.742</td>
<td>0.697</td>
</tr>
<tr>
<td>CIN5</td>
<td>0.923</td>
<td>0.793</td>
<td>0.697</td>
<td>0.788</td>
<td>0.710</td>
<td>0.734</td>
<td>0.691</td>
</tr>
<tr>
<td>CIN6</td>
<td>0.900</td>
<td>0.791</td>
<td>0.694</td>
<td>0.828</td>
<td>0.732</td>
<td>0.751</td>
<td>0.711</td>
</tr>
<tr>
<td>CIN7</td>
<td>0.938</td>
<td>0.831</td>
<td>0.726</td>
<td>0.813</td>
<td>0.752</td>
<td>0.764</td>
<td>0.706</td>
</tr>
<tr>
<td>DGO1</td>
<td>0.800</td>
<td>0.892</td>
<td>0.747</td>
<td>0.722</td>
<td>0.795</td>
<td>0.838</td>
<td>0.753</td>
</tr>
<tr>
<td>DGO2</td>
<td>0.828</td>
<td>0.914</td>
<td>0.730</td>
<td>0.749</td>
<td>0.765</td>
<td>0.808</td>
<td>0.743</td>
</tr>
<tr>
<td>DGO3</td>
<td>0.773</td>
<td>0.903</td>
<td>0.724</td>
<td>0.686</td>
<td>0.759</td>
<td>0.761</td>
<td>0.721</td>
</tr>
<tr>
<td>DGO4</td>
<td>0.819</td>
<td>0.928</td>
<td>0.756</td>
<td>0.758</td>
<td>0.785</td>
<td>0.806</td>
<td>0.785</td>
</tr>
<tr>
<td>DGO5</td>
<td>0.828</td>
<td>0.930</td>
<td>0.724</td>
<td>0.766</td>
<td>0.773</td>
<td>0.807</td>
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<tr>
<td>DGO6</td>
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<td>0.926</td>
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<td>0.752</td>
<td>0.790</td>
<td>0.823</td>
<td>0.783</td>
</tr>
<tr>
<td>DGO7</td>
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<td>0.835</td>
<td>0.741</td>
<td>0.675</td>
<td>0.796</td>
<td>0.761</td>
<td>0.753</td>
</tr>
<tr>
<td>EST1</td>
<td>0.701</td>
<td>0.709</td>
<td>0.841</td>
<td>0.628</td>
<td>0.678</td>
<td>0.720</td>
<td>0.742</td>
</tr>
<tr>
<td>EST2</td>
<td>0.712</td>
<td>0.698</td>
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<td>0.650</td>
<td>0.665</td>
<td>0.688</td>
<td>0.721</td>
</tr>
<tr>
<td>EST3</td>
<td>0.680</td>
<td>0.730</td>
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<td>0.725</td>
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<td>0.671</td>
<td>0.680</td>
<td>0.795</td>
</tr>
<tr>
<td>EST6</td>
<td>0.705</td>
<td>0.749</td>
<td>0.864</td>
<td>0.625</td>
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<td>0.752</td>
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</tr>
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<td>0.729</td>
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<td>0.850</td>
<td>0.618</td>
<td>0.637</td>
<td>0.599</td>
</tr>
<tr>
<td>EVA2</td>
<td>0.771</td>
<td>0.738</td>
<td>0.674</td>
<td>0.898</td>
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<td>0.697</td>
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<td>EVA3</td>
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<td>0.745</td>
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<td>0.899</td>
<td>0.668</td>
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<td>0.656</td>
</tr>
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<td>0.749</td>
<td>0.674</td>
<td>0.927</td>
<td>0.691</td>
<td>0.711</td>
<td>0.673</td>
</tr>
<tr>
<td>EVA5</td>
<td>0.755</td>
<td>0.703</td>
<td>0.629</td>
<td>0.909</td>
<td>0.618</td>
<td>0.630</td>
<td>0.626</td>
</tr>
<tr>
<td>EVA6</td>
<td>0.726</td>
<td>0.668</td>
<td>0.573</td>
<td>0.887</td>
<td>0.600</td>
<td>0.634</td>
<td>0.579</td>
</tr>
<tr>
<td>EVA7</td>
<td>0.776</td>
<td>0.724</td>
<td>0.613</td>
<td>0.892</td>
<td>0.635</td>
<td>0.666</td>
<td>0.605</td>
</tr>
<tr>
<td>MGO1</td>
<td>0.807</td>
<td>0.864</td>
<td>0.785</td>
<td>0.720</td>
<td>1.000</td>
<td>0.837</td>
<td>0.792</td>
</tr>
<tr>
<td>MRL1</td>
<td>0.614</td>
<td>0.646</td>
<td>0.598</td>
<td>0.554</td>
<td>0.600</td>
<td>0.777</td>
<td>0.628</td>
</tr>
<tr>
<td>MRL2</td>
<td>0.659</td>
<td>0.702</td>
<td>0.595</td>
<td>0.599</td>
<td>0.677</td>
<td>0.814</td>
<td>0.617</td>
</tr>
<tr>
<td>MRL3</td>
<td>0.695</td>
<td>0.755</td>
<td>0.691</td>
<td>0.637</td>
<td>0.702</td>
<td>0.855</td>
<td>0.714</td>
</tr>
<tr>
<td>MRL4</td>
<td>0.761</td>
<td>0.810</td>
<td>0.764</td>
<td>0.665</td>
<td>0.758</td>
<td>0.908</td>
<td>0.749</td>
</tr>
<tr>
<td>MRL5</td>
<td>0.804</td>
<td>0.823</td>
<td>0.773</td>
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<td>0.786</td>
<td>0.900</td>
<td>0.768</td>
</tr>
<tr>
<td>MRL6</td>
<td>0.668</td>
<td>0.731</td>
<td>0.671</td>
<td>0.624</td>
<td>0.692</td>
<td>0.843</td>
<td>0.712</td>
</tr>
<tr>
<td>MRL7</td>
<td>0.784</td>
<td>0.817</td>
<td>0.750</td>
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<td>0.785</td>
<td>0.907</td>
<td>0.785</td>
</tr>
<tr>
<td>MRL8</td>
<td>0.750</td>
<td>0.780</td>
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<td>0.658</td>
<td>0.721</td>
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<td>0.716</td>
</tr>
<tr>
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<td>0.796</td>
<td>0.865</td>
<td>0.682</td>
<td>0.758</td>
<td>0.808</td>
<td>0.948</td>
</tr>
<tr>
<td>PRC2</td>
<td>0.753</td>
<td>0.815</td>
<td>0.843</td>
<td>0.680</td>
<td>0.779</td>
<td>0.810</td>
<td>0.958</td>
</tr>
<tr>
<td>PRC3</td>
<td>0.722</td>
<td>0.779</td>
<td>0.843</td>
<td>0.648</td>
<td>0.746</td>
<td>0.761</td>
<td>0.940</td>
</tr>
<tr>
<td>PRC4</td>
<td>0.704</td>
<td>0.756</td>
<td>0.836</td>
<td>0.642</td>
<td>0.693</td>
<td>0.755</td>
<td>0.921</td>
</tr>
<tr>
<td>PRC5</td>
<td>0.737</td>
<td>0.786</td>
<td>0.839</td>
<td>0.657</td>
<td>0.739</td>
<td>0.766</td>
<td>0.927</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Parameter</th>
<th>Values obtained from the model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$ index</td>
<td>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.</td>
</tr>
<tr>
<td>Effect $f^2$</td>
<td>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.</td>
</tr>
<tr>
<td>Standardized path coefficients $\beta$</td>
<td>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.</td>
</tr>
<tr>
<td>Bootstrapping analysis</td>
<td>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.</td>
</tr>
</tbody>
</table>
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 established 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 10. $R^2$ of the latent dependent variables

<table>
<thead>
<tr>
<th></th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIN</td>
<td>0.652</td>
<td>0.650</td>
</tr>
<tr>
<td>EVA</td>
<td>0.730</td>
<td>0.728</td>
</tr>
<tr>
<td>MGO</td>
<td>0.779</td>
<td>0.775</td>
</tr>
</tbody>
</table>

Table 11. $f^2$ of the dependent latent variables

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CIN</td>
<td>DGO</td>
<td>EST</td>
<td>EVA</td>
<td>MGO</td>
<td>MRL</td>
</tr>
<tr>
<td>CIN</td>
<td>2.697</td>
<td>0.185</td>
<td>0.014</td>
<td></td>
<td>1.872</td>
<td>0.055</td>
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</tbody>
</table>

Table 12. Standardized path coefficients

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CIN</td>
<td>DGO</td>
<td>EST</td>
<td>EVA</td>
<td>MGO</td>
<td>MRL</td>
</tr>
<tr>
<td>CIN</td>
<td>0.854</td>
<td>0.481</td>
<td>0.134</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DGO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EST</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EVA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGO</td>
<td>0.807</td>
<td>0.255</td>
<td>0.057</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

---

**Table 13. Relationships among constructs**

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

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