



JISTEM: Journal of Information Systems and
Technology Management

E-ISSN: 1807-1775

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EFFECTIVENESS RELATES TO THREE CLASSICAL MECHANISMS
JISTEM: Journal of Information Systems and Technology Management, vol. 11, núm. 2, mayo-agosto,
2014, pp. 297-326
Universidade de São Paulo
São Paulo, Brasil

Available in: <http://www.redalyc.org/articulo.oa?id=203231729006>

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INFORMATION TECHNOLOGY GOVERNANCE IN PUBLIC ORGANIZATIONS: HOW PERCEIVED EFFECTIVENESS RELATES TO THREE CLASSICAL MECHANISMS

GOVERNANÇA DE TI EM ORGANIZAÇÕES PÚBLICAS: COMO A EFETIVIDADE PERCEBIDA SE RELACIONA COM TRÊS MECANISMOS CLÁSSICOS

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ABSTRACT

Information technology (IT) governance has received a lot of attention lately, with a growing strategic importance currently being given to IT by both public and private organizations. This justifies the existence of a body of scientific literature on IT governance, to which this paper belongs and makes an attempt to contribute to. Towards that end, an empirical study was performed involving 57 public organizations of the Brazilian federal administration, examining the relationship between three governance mechanisms – IT steering committee, IT solution manager, and IT investment portfolio management process and IT governance effectiveness. Based on the literature review, a conceptual model was developed to express the causal relations that these constructs were expected to hold with one another. Through a custom-designed questionnaire submitted to over 180 federal public employees, the causal model was tested using mediation analysis and mostly confirmed. Results indicate that Portfolio Management should always be taken into account for analyses that aim to evaluate the effects of IT steering committees and solution managers on IT governance effectiveness. This means that a nonexistent or an underperforming Portfolio Management Process can lead to a reduction or cancellation of the potential positive

Manuscript first received/*Recebido em*: 13/04/2013 Manuscript accepted/*Aprovado em*: 26/06/2014

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contributions of the other two mechanisms to IT governance. By informing decision makers and public managers at some of the main federal public organizations in the country on how to plan and deploy IT to promote a more effective governance, the conclusions presented herein fill a previous knowledge gap in the complementarity and the joint effectiveness of three IT governance mechanisms on the IT dynamics of key public organizations.

Keywords: IT governance; Public organizations; Public administration; Effectiveness; Governance mechanisms; Information Technology; Mediation analysis; Governance.

RESUMO

A Governança de TI é uma área de estudos recente que tem despertado muito interesse devido à importância cada vez maior da Tecnologia da Informação (TI) para as organizações, sejam elas públicas ou privadas. Isso justifica a existência de uma literatura científica sobre o tema governança de TI na qual este estudo se enquadra e para cujo desenvolvimento busca contribuir. Para tanto, realizou-se pesquisa empírica envolvendo 57 organizações públicas integrantes do governo federal brasileiro na qual foram examinadas as relações entre três mecanismos de governança – Comitê de TI, Gestores da Solução de TI e Processo de Portfólio de Investimento em TI – e a Efetividade da Governança de TI. Com base na literatura revisada, um modelo conceitual foi proposto para expressar as relações que esses construtos deveriam ter uns com os outros. Um questionário foi desenvolvido com base nesse modelo e aplicado a mais de 180 servidores públicos federais. As relações Causais foram testadas com análise de mediação e detectadas, em sua maioria, de acordo com o modelo. Os resultados indicam que o desempenho do Processo de Portfólio deveria sempre ser considerado em análises que tenham por objetivo avaliar os efeitos de Comitê de TI e de Gestores da Solução na efetividade da governança de TI. Isso significa que a não existência ou o baixo desempenho do Processo de Portfólio pode reduzir ou anular a contribuição positiva dos outros dois mecanismos para a efetividade da governança de TI. Por informar tomadores de decisão e gestores dos resultados em algumas das principais organizações da administração federal brasileira no planejamento e utilização TI em busca de efetividade da governança, as conclusões apresentadas neste artigo preenchem um vazio de conhecimento sobre as complementaridades e os efeitos de três mecanismos de governança na dinâmica dessas organizações.

Palavras-chave: Governança de TI; Organizações públicas; Administração pública; Efetividade; Mecanismos de governança; Tecnologia da Informação; Análise de mediação; Governança.

1. INTRODUCTION

Information Technology (IT) is currently considered a critical and strategic asset for organizations, both public and private (Affeldt & Vanti, 2009; Albertin & Albertin, 2008a; Albertin & Albertin, 2008b; Assis, 2011; ISACA, 2012).

In order for an institution to obtain the benefits expected from IT use, at acceptable levels of risk and cost, IT governance must be established and maintained (ABNT, 2009; Assis, 2011; Machado, 2007; Ramos, 2009). IT governance can be understood as a set of policies, organizational structures, work processes, roles and responsibilities that are established by the top management in order to steer IT actions and exert control over the use and management of IT throughout the institution (Mello, 2006; Mendonça, 2013; ISACA, 2012).

Studies carried out at the international level by Weill & Ross (2006) and at the national level by Lunardi, Becker & Maçada (2012) reveal that companies that had implemented IT governance performed better in comparison to those that did not or those with a deficient implementation.

An IT governance mechanism that is often mentioned in literature and recommended by audit entities such as TCU – the Brazilian SAI (Supreme Audit Institution) – is the IT Steering Committee or IT Executive Committee (BRASIL, 2008). Surprisingly, a study carried out by Ali & Green (2012) has not identified statistically significant relationships between the action of the IT steering committee and the effectiveness of IT governance, reaching a paradoxical conclusion. That study, though gave priority to private companies and the sample was intentionally filtered in order to include only institutions with a certain level of indirect execution (outsourcing) of IT activities. Therefore, it would not be appropriate to generalize the conclusions of that study to all situations. Further investigations are required. Additionally, it must be taken into account that the respondents to the Ali & Green (2012) survey were representatives of only one group of stakeholders of enterprise IT: IT auditors.

This apparent contradiction provided the initial motivation for the present study as it pointed out the need for investigation that would take into account the specificities of public institutions and engage other stakeholders. Another motivation was the opportunity to include the observation of two IT governance mechanisms in the analysis, which, according to the theoretical framework surveyed, would be closely related to the actions of the IT Executive Committee, namely: the IT Investment Portfolio Management Process and the IT Solution Manager.

Another aspect that has raised our interest in carrying out the present research was the lack of materials available in terms of best practice models, scientific papers and publications in general specifically addressing IT governance in public institutions.

Hence, based on widely disseminated assumptions regarding good practices in IT governance, the aim of the present study is to empirically investigate the relationships that exist between the following IT governance mechanisms at federal

public institutions: IT Investment Portfolio Management Process, IT Steering Committee and IT Solution Manager.

Accordingly, our research question is: “How does the action of the IT Committee and of IT Solution Managers relate to the performance of the IT Investment Portfolio Management Process and how do these three mechanisms interact with the effectiveness of IT Governance?”. It should be highlighted that only federal public institutions have been included in this research and that we did not aim for an institutional perspective, but for the personal perception of public employees representing the multiple stakeholders of the IT organization.

This paper provides empirical evidence that sheds new light on the relationships that exist between the IT governance mechanisms investigated. It can support public institutions in their implementation of IT governance, as well as provide input for recommendations issued by auditing authorities to the entities under their jurisdiction.

Below, is a brief theoretical framework on the effectiveness of IT governance and the governance mechanisms that have been evaluated and presented, followed by a description of the methods used in the research. Later, we present the results obtained and discuss our conclusions and final remarks.

2. THEORETICAL FRAMEWORK

2.1 IT governance effectiveness

Effective IT governance contributes to improved IT performance, which, on its turn, contributes to improved organizational performance (Assis, 2011; Machado, 2007; Mendonca et al., 2013; Weill & Ross, 2006). But, one might ask, what is an improved organizational performance? A quite objective answer is provided in Cobit 5, an important IT governance framework, that associates IT performance and organizational performance via the creation of value for the business and clarifies that “creating value is to realize benefits at optimal resource cost whilst optimizing risk” (ISACA, 2012, p. 17).

Value creation can also be described as the achievement of certain IT objectives related to certain generic corporate goals, applicable to all organizations (ISACA, 2012, p. 18, Figure 4). These objectives aim to ensure the following aspects, among others: that planned actions and those under way in the IT departments be aligned with the organization’s business strategy, so as to give priority to the most important requests of the business to the IT department; that meeting these requests should be in compliance with the requirements, deadlines, quality and the costs agreed; that costs and risks of IT initiatives should be managed and that the expected benefits of the IT actions carried out should be achieved (ISACA, 2012b).

Along the same lines, Dolci & Maçada (2011) have identified a comprehensive set of benefits targeted by organizations regarding different dimensions of IT investments.

As a higher degree of fulfillment of objectives leads to the creation of greater value – which implies in a greater effectiveness of IT governance – this causal relationship justifies the use of the aspects addressed by the objectives mentioned in the

questions of the survey form that evaluated the effectiveness of IT governance (Appendix A, item 4).

2.2 IT investment portfolio management

Portfolio management has become a popular topic following the publication of Markowitz (1952), aimed at financial markets. McFarlan (1981) and Ward (1990) have pioneered the use of the portfolio approach in selecting IT investments.

Studies carried out by Weill, Woerner & Rubin (2008) have followed up on the evolution of the use of the IT governance concepts and practices by large private international corporations. In the national scenario, Moraes & Laurindo (2003) have shown positive results obtained from the implementation of the IT project portfolio management process. Dolci & Maçada (2011), was based on case studies carried out with national companies with high investments in information technology, have identified the most important aspects to be considered by the four dimensions usually taken into account regarding IT investment portfolios.

Cobit 5 (ISACA, 2012b) includes IT investment portfolio management among decision-making tools and for supporting the monitoring of actions associated to IT management and use. In this model, the topic is addressed by the following processes and practices:

- a) In the domain of IT governance: EDM02.01 *Evaluate value optimisation*, EDM02.02 *Direct value optimization* and EDM02.03 *Monitor value optimisation*;
- b) In the domain of IT management: APO05.01 *Establish the target investment mix*, APO05.02 *Determine the availability and sources of funds*, APO05.03 *Evaluate and select programmes to fund*, APO05.04 *Monitor, optimise and report on investment portfolio performance*, APO05.05 *Maintain portfolios* and APO05.06 *Manage benefits achievement*.

In the ValIT framework (ITGI, 2008), IT investment portfolio management is addressed under the Portfolio Management (PM) domain. Its objective is to guarantee that organizations may obtain optimal value for its IT investments. Practices associated with portfolio evaluation and balancing fall within this domain, as well as the definition of criteria for these activities. ValIT also addresses the follow up of the portfolios overall performance.

Valuable information sources on how to establish or improve the IT investment portfolio process are: the ITIM framework, designed and published by the United States General Accounting Office (GAO, 2004) and the study carried out by Weill, Woerner & McDonald (2009). The standard defined under The Standard for Portfolio Management (PMI, 2008) and the model proposed by Archer & Ghasemzadeh (1999) differentiate themselves in one aspect: they are not limited to the management of IT portfolios, but are also applicable to the management of institutional program and project portfolios in general.

As described by the above-mentioned sources, the objective of the IT investment portfolio management process is to optimize the use of institutional resources, so as to select a set of projects and programs capable of providing the

greatest possible returns to the organization. Selected projects and programs must be aligned with corporate strategies and, according to the methodology, their risks, costs, quality, deadlines and levels of service must be properly managed. It has been said that, in order to meet its objectives, a portfolio management process requires the definition of decision-making structures and the fulfillment of some common stages or phases. Despite the fact that each model uses slightly different names, the main ones are: identification and analysis of components/projects, selection and prioritization of components, authorization, monitoring, reviews and risk management. Requirements for portfolio management are project management and program management, but are not limited to them.

This set of characteristics described in literature has provided input for the phrasing of the survey questions that evaluated the performance of the governance mechanism of the IT Investment Portfolio Process (Appendix A, item 1).

The objective and the characteristics of the portfolio management process are clearly congruent with the objectives of the so-called focus areas of IT Governance: strategic alignment, value delivery, resource management, risk management and performance measurement (ITGI, 2007). Hence, it is reasonable to consider the following hypothesis: improvements in the performance of the IT investment portfolio process have a positive influence on the effectiveness of IT governance (hypotheses H3 in Figure 1).

2.3 IT solution manager

There are several different names for the “IT Solution Manager” governance mechanism: business executive, business area, project or investment sponsor or business process owner. In the present article we have chosen to use “IT Solution Manager”, as it can be applied to the whole life cycle of an IT solution; it also is less restrictive, as IT may support not only business processes in the strict sense of the word, but also administrative processes, support processes and even processes of the IT department itself.

The role of the TCU IT Solution Manager is internally regulated by TCU Administrative Order no. 156 of 2012 (BRASIL, 2012), whereas other public entities have their own norms on that issue.

It should be noticed that, even though restricted to situations involving the provision of contract-based IT solutions, Normative Instruction no. 4/2010 of the Secretariat for Logistics and Information Technology of the Ministry of Planning, Budgeting and Management (SLTI), the central authority of the System for the Administration of Information Resources and Information Technology of the Federal Executive Power (SISP), defines some attributions of the IT Solution Manager role in the items that address the responsibilities of the contracting planning team (BRASIL, 2010).

Within the ValIT framework (ITGI, 2008), the relevance of the IT solution manager role is expressed in the *Investment Management* (IM) domain of that model. Its objective is to guarantee that individual portfolio components may contribute to generating value for the organization. This domain includes practices related to the

identification of business requirements, expected benefits, as well as the preparation of the *Business Case*, a document that issues a formal request and registers essential information about the initiative. It also addresses the follow up of individual performance, i.e., monitors the fulfillment of the benefits of the program or project throughout their life cycle.

In Cobit 5 (ISACA, 2012b), the responsibilities of the IT Solution Manager are presented under different items of the framework. The “RACI” tables show the responsibilities attributed to the Business Executive or the Business Process Owner, i.e., to the unit or sector benefitting from the investments in the IT solution. That can be noticed, especially, in the description of the following processes, key practices and activities of Cobit 5: BAI01 *Manage Programmes and Projects* (several key practices), BAI02 *Manage Requirements Definition* (several key practices), APO12 *Manage Risk*, APO05.06 *Manage benefits achievement*, APO09.03 *Define and prepare service agreements* and PO09.04 *Monitor and report service levels*.

According to the IT Governance Institute, an IT Solution Manager is responsible for: acting as the sponsor of the IT solution, defining business requirements for the IT solution; defining and controlling levels of service for the IT solution; continuously evaluating the benefits of the IT solution; evaluating the risks to the business that are associated with the IT solution; providing resources and establishing priorities for the IT solution, among other responsibilities (ITGI, 2003, p. 51).

Peppard, Ward & Daniel (2007) have revealed that the value of IT investments can only be obtained by means of an ongoing identification and management of the benefits achieved throughout the whole life cycle of the IT solution. And this is the responsibility of business managers, i.e., this responsibility lies with those who we have called “IT Solution Manager”.

For the purposes of this study we have considered that the IT Solution Manager is the organizational unit with the greatest interest in the investment, development or hiring of an IT solution (be it a system, software, app or service provided by the IT department). It should be noted that, even though the operational activities of the IT Solution Manager can be delegated to sub-units, departments or specialists, this is not relevant to the analysis proposed in this study.

The questions of the survey that evaluated the performance of the IT Solution Manager governance mechanism were based on the set of characteristics described in literature (see Appendix A, item 3).

The responsibilities of the IT Solution Manager described herein can be easily related to the common roles found in portfolio process models, such as the sponsor and program manager roles (PMI, 2008), including activities that are considered necessary at certain stages or phases of a portfolio management process, especially during the *identification*, *authorization*, *review and report*, and *risk management* stages (PMI, 2008), as well as during the *individual project analysis*, *project development* and *phase-gate evaluation* phases (Archer & Ghasemzadeh, 1999). Therefore, the following hypothesis is to be considered: improvements in the actions of IT solution managers have a direct and positive influence on the performance of the IT investment portfolio process (hypothesis H2 in Figure 1). Likewise, this simple logical and causal

relationship seems to indicate that several attributions of the IT Solution Manager can contribute to the fulfillment of the following objectives of IT Governance focus areas: value delivery, resource management, risk management and performance measurement (ITGI, 2007). Therefore, it is reasonable to consider the following hypothesis as well: improvements in the performance of IT solution managers have a direct and positive influence on the effectiveness of IT governance (hypothesis H5 in Figure 1).

2.4 IT Steering Committee

Weill & Ross (2006) have evaluated large numbers of large international corporations over several years and report that IT Steering Committees are important governance mechanisms used by top performing companies. Castro & Carvalho (2010) also have identified the need for a committee composed by representatives of several different areas of the organization to take decisions regarding the selection and prioritization of projects. Likewise, a case study that has been evaluated by Moraes & Laurindo (2003) shows positive results deriving from the joint participation of managers from IT and business areas in the decision-making associated to the selection and prioritization of projects.

The organization is responsible for establishing an IT Steering Committee, composed of directors and managers from the IT and business areas. Among other responsibilities, as established in Cobit 5 under APO01.01 *Define the organizational structure* key practice, that the committee should: “determine prioritisation of IT-enabled investment programmes in line with the enterprises business strategy and priorities; track status of projects and resolve resource conflicts; and monitor service levels and service improvements” (ISACA, 2012b).

Cobit 5 (ISACA, 2012b) also presents other attributions of the IT Steering Committee in its “RACI” tables. That can be especially noticed in the descriptions of the following processes, key practices and activities: BAI01 *Manage Programmes and Projects* (several key practices), APO12 *Manage Risk*, and APO05.06 *Manage benefits achievement*.

According to the IT Governance Institute, it is the responsibility of the IT Steering Committee to: participate in the approval of new IT solutions; evaluate the alignment of proposals for new IT solutions with the organizational strategies; define priorities for projects; ensure that all costs and benefits of the proposals for new IT solutions have been identified; guarantee that projects are being risk-managed; follow up the progress of relevant IT projects, among other responsibilities (ITGI, 2003, p. 52).

According to TCU, all public organizations, in addition to other actions, must establish an IT steering committee, “in order to provide for the allocation of public resources in accordance with the organization’s needs and priorities” (BRASIL, 2008). In compliance with its own recommendations, the TCU has implemented a governance mechanism, as part of the Court’s internal processes, for that end, called IT Management Committee. The responsibilities of the Committee are established under TCU Resolution no. 247/2011 (BRASIL, 2011) and TCU Administrative Order no. 156/2012 (BRASIL, 2012).

In line with the best IT governance practices and the recommendations of the audit entities, the SISP Information Technology General Strategy (*Estratégia Geral de Tecnologia da Informação – EGTI*) for the 2011-2012 period also foresees the establishment of IT Committees by the organizations that are part of the system (BRASIL, 2011b).

The IT Committee that was evaluated by this study holds the characteristics and attributions of the IT steering committee described in the sources mentioned above, having thus set the basis for the drafting of questions for the survey questionnaire which have evaluated the governance mechanism (Appendix A, item 2).

It can be easily noticed that the attributions of the IT steering committee described herein are related to the usual roles found in portfolio process models, such as the Portfolio Review Board and the Portfolio Manager roles (PMI, 2008). Their activities are considered necessary during the stages or phases of a portfolio management process, especially during the prioritize, balance, authorize, review and report and risk management stages (PMI, 2008), or during the *optimal portfolio selection* and *phase-gate evaluation* (Archer and Ghasemzadeh, 1999) phases. Hence, the evaluation of the following hypothesis is applicable: improvements in the action of the IT committee have a direct and positive influence on the performance of the IT investment portfolio (hypothesis H1 in Figure 1).

Additionally, it can be noticed that there are intersections between the attributions of the IT Steering Committee and the following objectives of the IT Governance focus areas: strategic alignment, value delivery and risk management (ITGI, 2007). Therefore, it is reasonable to consider the following hypothesis as well: improvements in the performance of the IT Steering Committee have a direct and positive influence on the effectiveness of IT governance (hypothesis H4 in Figure 1).

2.5 Conceptual model

This study intends to investigate the conceptual model presented in Figure 1. The variables analyzed – which are often mentioned in several parts of this document – match the identifiers shown in brackets in each rectangle of the figure: COMITE, GESTSOL, PROCPORTF and EFETGOVTI.

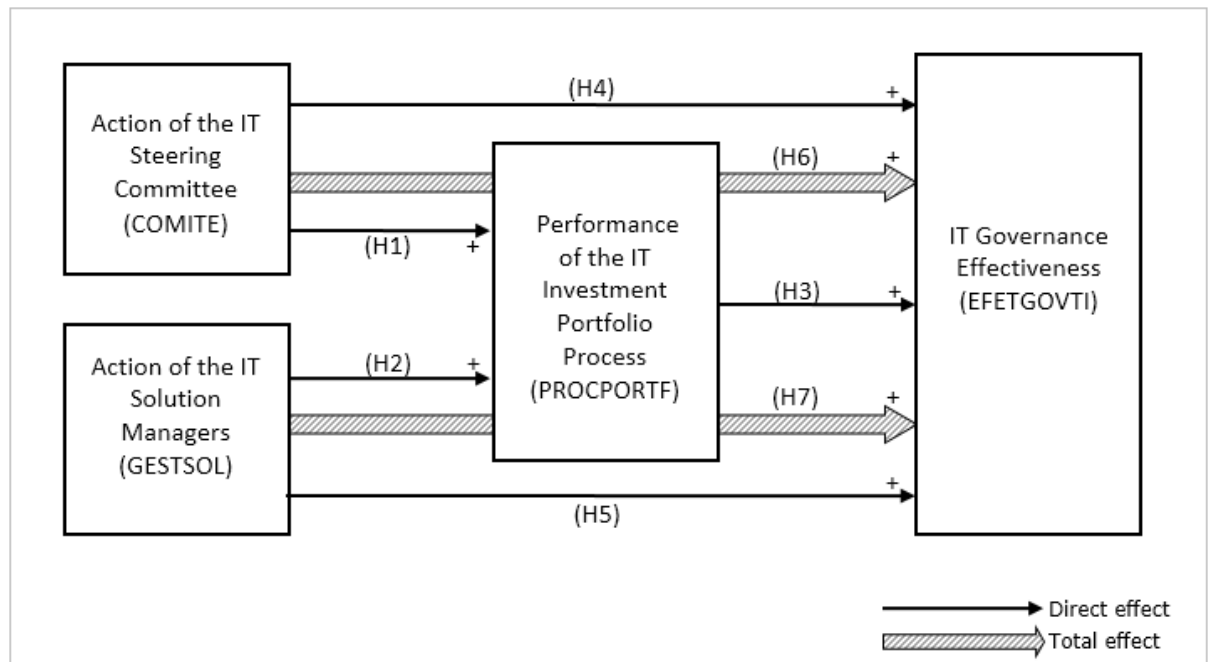


Figure 1 – Conceptual model and hypotheses

The hypotheses that will be evaluated in this study, concerning the relationships between governance mechanisms and between these and IT governance effectiveness, are represented by arrows and identifiers in Figure 1, namely:

- a) H1: Improved action by the IT steering committee has a direct and positive influence on the performance of the IT investment portfolio process.
- b) H2: Improved action by IT solution managers has a direct and positive influence on the performance of the IT investment portfolio process.
- c) H3: Improved performance of the IT investment portfolio process has a direct and positive influence on IT governance effectiveness.
- d) H4: Improved action by the IT steering committee has a direct and positive influence on IT governance effectiveness.
- e) H5: Improved action by the IT solution managers has a direct and positive influence on IT governance effectiveness.
- f) H6: The overall effect of improvements in IT steering committee action is positive on IT governance effectiveness, i.e., the balance between the direct and indirect effects, via portfolio process, of IT committee action on IT governance effectiveness is a positive one.
- g) H7: The overall effect of improvements in IT solution manager action is positive on IT governance effectiveness, i.e., the balance between the direct and indirect effects, via portfolio process, of IT solution manager action on IT governance effectiveness is a positive one.

3. METHODS

The survey was done through a questionnaire made available over the Internet between October 10th, 2012 and October 15th, 2012. Federal public servants made up the target audience, encompassing the following IT stakeholders in the participating organizations: internal IT clients, IT servants, internal auditors and IT consultants, encompassing managers and non-managers.

The survey was distributed via email to the representatives of the *TI Controle* community, which gathers several IT managers from federal public institutions. SLTI sent the same survey to public servants that had subscribed to the entity's portal as well. Additionally, the survey organizer spread it to its contacts and provided a website to facilitate the collection of information and access to the form by interested respondents.

The four questions of the questionnaire that evaluated IT Steering Committee action (COMITE), the five questions that evaluated the IT Solution Manager action (GESTSOL) and the five questions that evaluated the IT investment portfolio process (PROCPORTF) had been drafted based on the main characteristics of these governance mechanisms, as described in academic studies, best practice models and other literature sources reviewed. All questions related to independent variables and mediator (COMITE, GESTSOL and PROCPORTF) had been measured according a 5-point Likert scale, which evaluated two dimensions for each question: i) the relevance of the question for IT governance effectiveness, as perceived by the respondent; ii) the degree to which the action or activity proposed by the question had been fulfilled by the institution, according to the respondent's perception. Figure 2 is an example of how these two dimensions evaluated for one of the questions addressing the COMITE variable.

| 2.4 The IT committee follows up/monitors the realisation of benefits, costs and risks of the most important IT solutions, during the project phase and the operations and maintenance phase. | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | 1 | 2 | 3 | 4 | 5 |
| What is said is FULFILLED by the institution | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| It is IMPORTANT to fulfill what is said | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Figure 2 – Sample question for the evaluation of the “relevance” and “fulfillment” dimensions

The dependent variable – IT governance effectiveness (EFETGOVTI) – was evaluated through a proxy: the respondents' satisfaction regarding the achievement of objectives and the realization of the benefits that are expected from good IT governance and management, aiming at the creation of value for the organization, as stated in the

literature review section. The six questions regarding this variable were also evaluated based on a 5-point Likert scale.

For each variable analyzed in the survey, Chart 1 summarizes the main reference sources on the topic and the questionnaire items (Appendix A) that represent the questions used for measuring these variables.

| Variable | Main Bibliographic References | Questionnaire Questions (Appendix A) | Cronbach's Alpha Coefficient |
|------------|--|---|---------------------------------|
| PROCPORFTF | MCFARLAN, 1981; WARD, 1990; ARCHER & GHASEMZADEH, 1999; GAO, 2004; ITGI, 2008; PMI, 2008; WEILL, WOERNER & MCDONALD, 2009; ISACA, 2012b. | Items 1.1 to 1.5 | 0.7938 |
| COMITE | ITGI, 2003, p. 52; MORAES & LAURINDO, 2003; WEILL & ROSS, 2006; BRASIL, 2008; CASTRO & CARVALHO, 2010; BRASIL, 2011; BRASIL, 2011b; BRASIL, 2012; ISACA, 2012b; ALI & GREEN, 2012. | Items 2.1 to 2.4 | 0.8523 |
| GESTSOL | ITGI, 2003, p. 51; ITGI, 2007; ITGI, 2008; PEPPARD, WARD & DANIEL, 2007; BRASIL, 2010; ISACA, 2012b; BRASIL, 2012. | Items 3.1 to 3.5 | 0.7841 |
| EFETGOVTI | WEILL & ROSS, 2006; DOLCI & MAÇADA, 2011, Figure 2, p. 363; ISACA, 2012, p. 18, Figure 4; ISACA, 2012b, p. 226, Figure 17. | Items 4.1 to 4.6 | 0.8273 |

Chart 1 – Variables, bibliographic references and questionnaire questions

For the independent variables and the mediator variable (COMITE, GESTSOL and PROCPORFTF), their measurement in each answer was calculated as follows: for each question that is part of the variable, the average value obtained from the answers of all respondents to the “question relevance” dimension was used as a weight that was applied to each answer to the “degree of fulfillment” of the question. The weighted average of the set of questions of a variable times its weights, converted into a 10-point scale, generated a final average of this variable in each answer. The strategy for calculating the measure of a variable based on its components is based on the stated preference weights approach (Decancq & Lugo, 2010, p. 17), according to which the relevance/weight is defined by the respondents themselves.

For the dependent variable (EFETGOVTI), the average measure for each answer was calculated based on the simple average of values to the answers to their questions, converted into a 10-point scale. This strategy for calculating the measure of a variable based on its components was based on the expert opinion weights approach

(Decancq & Lugo, 2010, P. 16); all sources mentioned in the theoretical framework were considered experts – with an equivalent relevance – which provided the basis for the selection of questions.

The selection of items used for measuring the variables is fully justified as it is based on the opinions of respondents and of experts on the topic, according to the previously mentioned approaches. Nevertheless, we also carried out a statistical analysis of the internal consistence or reliability of the questionnaire items that make up each variable of the study. Chart 1 shows that the values of Cronbach's Alpha coefficient obtained for each variable fall within the acceptable range, that is, between 0.70 and 0.95 (Tavakol & Dennick, 2011). It also has been found that the eventual exclusion of items would not improve the Alpha coefficient value in none of the variables, which reinforces the relevance that is given to the items by literature.

The model presented in Figure 1 shows that the IT Steering Committee and the IT Solution Manager can have a direct effect on IT governance effectiveness, as well as indirect and total effects through the Portfolio Process. To evaluate the direct effects shown in this figure, we used the multiple regression analysis technique. In order to take into account the indirect and total effects, the mediation analysis statistics method was used in the study. Its aim is to test the relationships observed between a set of independent variables and a dependent variable upon the inclusion of an additional variable, known as mediator. In the mediated model, the hypothesis is that the independent variable influences the mediator variable, which, on its turn, influences the dependent variable. To be highlighted is that the models that can be analyzed with the method are not limited to three variables and can be applied to several models, with any number of dependent variables and mediator variables. The importance of this type of analysis has achieved notoriety following the studies by Baron and Kenny (1986), and very effective modern techniques are currently available, such as those mentioned by MacKinnon (2008) and Hayes (2009).

We used the "R" statistical software to calculate Cronbach's Alpha coefficient and carry out the multiple regression analysis, as well as the auxiliary correlation tests used in this study. For the mediation analysis we have used the SPSS® Statistics software and the "MEDIATE" (Hayes, 2012a) and "PROCESS" (Hayes, 2012b) macros, which are support tools available on the internet that can be accessed and used by the general public.

4. RESULTS

Below we present the characteristics of the sample and the results of the tests described in the previous section. To test the hypotheses shown in Figure 1, we initially explore the existing correlations between the variables and evaluated the direct effects by means of a multiple regression test. Next, in order to obtain the final results, we used the mediation test.

4.1 Sample characteristics

| Sample characteristics (N=189) | | | | | |
|---|--------------|--------------|---|--------------|--------------|
| <i>Characteristic</i> | <i>Qtty.</i> | <i>Perc.</i> | <i>Characteristic</i> | <i>Qtty.</i> | <i>Perc.</i> |
| <i>Institution (*)</i> | | | <i>Gender</i> | | |
| ANATEL | 5 | 2,6% | Male | 155 | 82,0% |
| BACEN | 3 | 1,6% | Female | 34 | 18,0% |
| CÂMARA DEP. | 4 | 2,1% | <i>Has taken some course on IT governance</i> | | |
| CAPES | 4 | 2,1% | Yes | 131 | 69,3% |
| CGU | 3 | 1,6% | No | 58 | 30,7% |
| DATAPREV | 3 | 1,6% | <i>Works in the IT department of the institution</i> | | |
| MDIC | 3 | 1,6% | Yes | 151 | 79,9% |
| MIN. PLANEJ. | 6 | 3,2% | No | 38 | 20,1% |
| MIN. FAZENDA | 3 | 1,6% | <i>Type of job/position</i> | | |
| SENADO FED. | 19 | 10,1% | Management | 92 | 48,7% |
| STN | 3 | 1,6% | Non-management | 97 | 51,3% |
| TST | 3 | 1,6% | <i>Works as IT auditor, IT consultant or IT advisor</i> | | |
| SERPRO | 3 | 1,6% | Yes | 84 | 44,4% |
| TCU | 72 | 38,1% | No | 105 | 55,6% |
| Others | 55 | 29,0% | | | |
| <i>Working years at the institution</i> | | | | | |
| Less than 3 years | 43 | 22,8% | | | |
| 3 to 6 years | 41 | 21,7% | | | |
| 6 to 12 years | 41 | 21,7% | | | |
| 12 to 20 years | 30 | 15,8% | | | |
| More than 20 years | 34 | 18,0% | | | |

(*) only institutions with at least 3 respondents are mentioned

Table 1 – Sample characteristics

Table 1 presents the distribution of respondents with regards to important grouping characteristics. Other peculiarities of the sample can be found in Appendix B. We had a total of 189 respondents, associated to 57 different institutions, and about one third of all respondents were TCU employees. The large number of TCU respondents can be explained by the fact that the research organizer works at TCU, which has facilitated communication and access to people. An analysis of the rate of respondents in relation to the requests made is not applicable as the main means of divulgation outside TCU were not under the control of the research organizer (indirect means: divulgation made by the IT Control Community and by SISP to its members).

4.2 Preliminary Analysis

The correlation test calculated the Pearson product-moment for each pair of variables and the multiple regression test allowed to estimate coefficients for the calculation of PROCPORF based on COMITE and GESTSOL and for the calculation

of EFETGOVTI based on these three variables. The results are summarized in Table 2 and Table 3, respectively.

| Variable | Average | Standard Deviation | Correlations | | | |
|------------|---------|-----------------------|--------------|---------|------------|-----------|
| | | | COMITE | GESTSOL | PROCPORTEF | EFETGOVTI |
| COMITE | 6.33 | 2.08 | 1 | - | - | - |
| GESTSOL | 6.11 | 1.58 | 0.38*** | 1 | - | - |
| PROCPORTEF | 6.03 | 1.59 | 0.41*** | 0.48*** | 1 | - |
| EFETGOVTI | 5.64 | 1.35 | 0.35*** | 0.40*** | 0.58*** | 1 |

Obs.: N=189; ***p< 0.001; ** p<0.010; * p<0.050; ^p<0.100

Table 2 – Averages, standard deviations and correlations between variables

As shown in Table 2, initial results indicate there is a statistically significant correlation between all variables of the model, which could support the validity of some of the hypotheses presented in Figure 1.

| Variable | D i r e c t e f f e c t s | |
|------------|---|--|
| | Coefficients to calculate PROCPORTEF | Coefficients to calculate EFETGOVTI |
| COMITE | 0.21*** (H1) | 0.07 (H4) |
| GESTSOL | 0.37*** (H2) | 0.11^ (H5) |
| PROCPORTEF | - | 0.41*** (H3) |

Obs.: N=189; ***p< 0.001; ** p<0.010; * p<0.050; ^p<0.100

Table 3 – Results of the regression tests, with estimates for the direct effects of COMITE and GESTSOL over PROCPORTEF and of these three variables over EFETGOVTI

Additionally, the results of the regression test, shown in Table 3, indicate that the direct effects of GESTSOL and COMITE over PROCPORTEF are substantial and statistically significant, which allows us to accept hypothesis H1 and H2 of Figure 1. The direct effects of PROCPORTEF over EFETGOVTI also have a high value and are statistically significant, which confirms hypothesis H3 of Figure 1.

The direct effects of GESTSOL and COMITE over EFETGOVTI evaluated by the regression test, though, demonstrated to be small and are not statistically

significant, with confidence levels lower than 95% and 90%, respectively, which leads us to reject hypotheses H4 and H5 of Figure 1.

4.3 Mediation analysis

According to the mediation analysis theoretical framework, the direct effect is calculated the same way as in the regression analysis, whereas the coefficient that measures the value of an indirect effect is given by the product of the coefficients of the mediated direct effects. The total effect, though, is calculated as the sum of the direct and indirect effects that have been measured between the same variables. Additionally, data must be submitted to hypothesis tests that allow the validation of the estimated values for such effects, that is, if they can be considered statistically significant (Baron & Kenny, 1986; Mackinnon, 2008; Hayes, 2009).

As seen, the preliminary regression analysis has rejected the direct effects of COMITE (H4) and GESTSOL (H5) on EFETGOVTI, which could discourage the performance of tests regarding the proof of total effects (H6 and H7). Nevertheless, it is known that a variable can have a positive total effect on another variable even though a direct effect is not identified (HAYES, 2012b). This is because its effect may occur through a third variable, a mediator.

In fact, the mediation analysis performed afterwards with the support of the “MEDIATE” macro (Hayes, 2012a) revealed statistically significant indirect effects and total effects, at a confidence level higher than 95% of the GESTSOL and COMITE variables on EFETGOVTI variables when considering the PROCPORTF variable as a mediator. In view of the results of the mediation analysis shown in Table 4, hypothesis H6 and H7 of Figure 1 can be accepted regarding the total effects of COMITE and GESTSOL over EFETGOVTI, respectively.

| Variable | Direct effects Over EFETGOVTI | Indirect effects via PROCPORTF | Total effects over EFETGOVTI |
|--|-------------------------------------|-----------------------------------|---------------------------------|
| COMITE | 0.07 | 0.08~ | 0.15** (H6) |
| GESTSOL | 0.11^ | 0.15~ | 0.26*** (H7) |
| Obs.: N=189; ***p< 0.001; ** p<0.010; * p<0.050; ^p<0.100; ~ i interval LLCI-ULCI does not contain 0 | | | |

Table 4 – Mediation test results, with estimates of the direct, indirect and total effects of COMITE and GESTSOL over EFETGOVTI

The mediation test was configured to simulate 10,000 samples or bootstrap samples, while the recommendation by Hayes (2009) is to use at least 5,000. It should be underscored that, in mediation tests using the bootstrap technique, the interpretation of the probability or confidence level of the indirect effect is not based on a “p” value, but on the values resulting from the LLCI-ULCI interval: if the interval does not

contain a zero value, the mediation hypothesis is accepted (Hayes, 2009; Hayes 2012a; Mackinnon, 2008).

In view of the high number of TCU respondents in the sample, the mediation test was repeated by excluding the answers of these participants, for comparison with the results obtained from the full sample. Despite the variations in the values of estimated coefficients for the reduced sample, it was found that the calculated direct, indirect and total effects presented similar results and led to statistically significant levels of confidence, such as those obtained from using the full sample.

4.4 Consolidated results

Figure 3 summarizes the results obtained from the mediation test: each path or hypothesis presents the estimated regression coefficient, rounded to two decimal places, as well as their statistical significance.

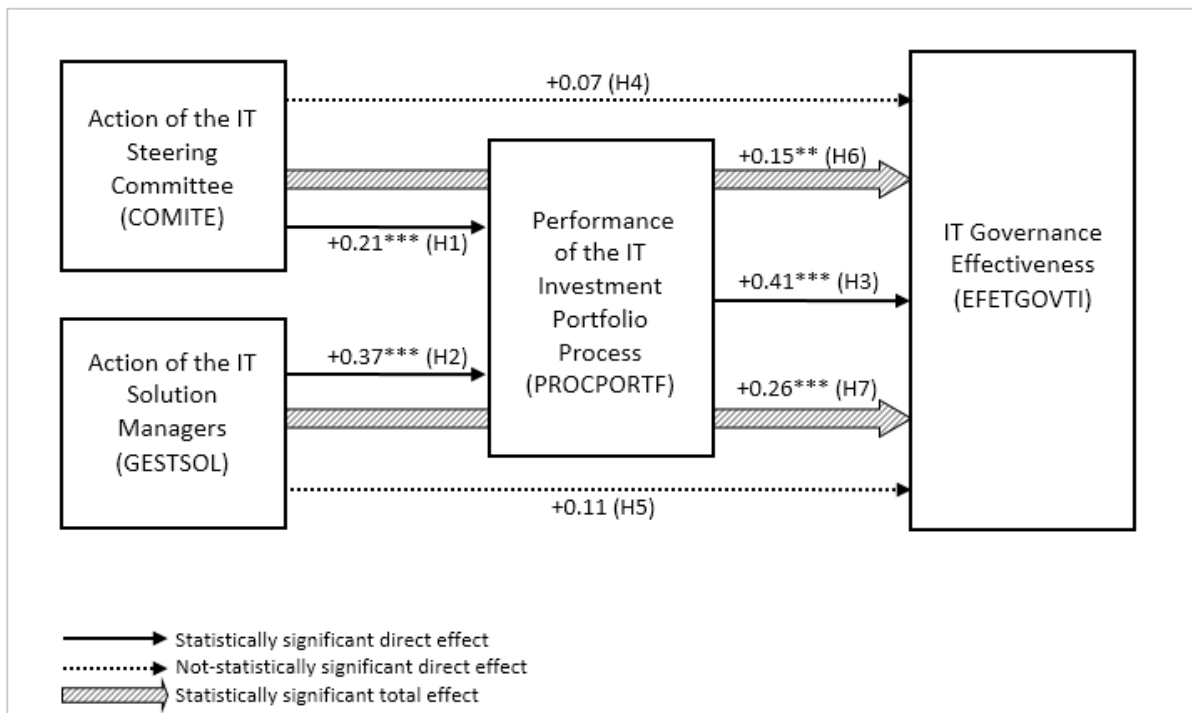


Figure 3 – Effects calculated through mediation analysis

The result of the mediation analysis allows us to discuss how the evaluated IT governance mechanisms relate to each other and with IT governance effectiveness. These relationships and effect sizes, on average, are summarized below on a scale from 0 to 1, which is typical of statistical regression and mediation tests:

- Each point of improved performance in the IT investment portfolio process is equivalent to 0.41 point of improvement on IT governance effectiveness (as per H3 in Figure 3);

b) Each point of improved IT Steering Committee action is equivalent to 0.15 improvement on IT governance effectiveness (as per H6 in Figure 3);

c) Each point of improved IT Solution Manager action is equivalent to 0.26 point improvement on IT governance effectiveness (as per H7 in Figure 3);

d) Each point of improved IT Steering Committee action is equivalent to 0.21 point improvement on the performance of the IT investment portfolio process (as per H1 in Figure 3);

e) Each point of improved IT Solution Manager action results on a 0.37 point improvement on the performance of the IT investment portfolio process (as per H2 in Figure 3).

It should be noted that in the case of COMITE and GESTSOL, this summary has considered the total effects on EFETGOVTI, as the result of the mediation analysis certifies that the effects these mechanisms indirectly exert on IT governance effectiveness, through its influence on the IT investment portfolio, are significant.

These results allow us to reach some important conclusions that can contribute to a better understanding of the specific topic being analyzed herein for the evolution of IT Governance as a field of study, and act as practical guidance for public organization leaders, managers and auditors regarding the implementation of the analyzed governance mechanisms, the planning of derived actions and in identifying training needs.

Because COMITE (H4) and GESTSOL (H5) have not been found to have statistically significant direct effects on EFETGOVTI, but that statistically significant total effects exist, and considering the mediation of PROCPORTF (H6 and H7), an important conclusion is: eventual efforts to improve the action of the IT Steering Committee and/or of IT Solution Managers depend on the existence of an Investment Portfolio Process in order to have relevant effects on IT governance effectiveness.

Finally, it can be concluded that the control entities and best-practice models mentioned in the conceptual sections of the paper are correct to recommend the use of the governance mechanisms analyzed herein, as the present study provides evidence of their contribution to the effectiveness of IT governance.

4.5 Other findings

In addition to the conclusions related to the research question and hypotheses presented in the conceptual model shown in Figure 1, other interesting findings, associated to the different group perceptions, are presented in Appendix B.

Even though these findings are not directly related to the research question and with the primary objective of the study, we took advantage of the opportunity offered by the collected data and carried out some additional exploratory analyses. The results of which are presented next, aiming at encouraging future complementary research on the topic.

In order to carry out these analyses, we used the Microsoft Excel® software and non-parametric tests provided by the XLSTAT add-in.

With regards to the perceived relevance of the three mechanisms for assessing IT governance effectiveness analyzed in the study (COMITE, GESTSOL, PROCPORTF), the evaluation has led to rather high averages for all groups, with a small standard deviation, as can be seen in Table B1, B2 and B3 of Appendix B. Despite unanimous agreement on the relevance of the mechanisms, there is statistically significant evidence of differences in the perception of the groups, namely:

- a) Regarding the relevance of the IT Portfolio Process, there is evidence that groups that have taken a course on IT governance and those that have not do have different perceptions. The same difference exists between IT personnel and IT client personnel, as well as between IT auditors/consultants and non-IT auditors/consultants (Table B1);
- b) Regarding the relevance of the IT Steering Committee, there is evidence of different perceptions between the respondents of other institutions and TCU respondents, as well as between the group that took the IT governance course and the group that did not take the course, as well as between IT auditors/consultants and non-IT auditors/consultants (Table B2);
- c) With regards to the importance of the IT Solution Manager, there is evidence of different perceptions by the group that took the course on IT governance and the group that did not, and also between IT auditors/consultants and non-IT auditors/consultants (Table B3).

There also is evidence of differences in perception between groups regarding the relevance of the eventual causes of non-effectiveness of IT governance that have been evaluated, as shown in Table B4:

- a) Reasonable difference in perception between TCU respondents and the respondents from other institutions regarding the relevance of Cause 1 – insufficient IT personnel, and also regarding Cause 4 – insufficient financial resources;
- b) Reasonable difference in perception between IT personnel and IT client personnel regarding the relevance of Cause 1 – insufficient IT personnel, Cause 2 – lack of technical training by IT personnel, Cause 5 – lack of exploitation of alternatives for the provision of IT solutions, and Cause 6 – lack of management training by IT personnel;
- c) Reasonable difference in perception between IT auditors/consultants and non-IT auditors/consultants regarding the relevance of Cause 4 – lack of financial resources.

It is important to note, regarding the results presented in Appendix B, that there is evidence that little difference exists in the perception of the group that exerts a management position and the group that does not carry out this type of activity. This is the case both for the perception about the relevance of the three IT governance mechanisms evaluated (tables B1, B2 and B3), as well as for the perception of the relevance of the six causes of the non-effectiveness of IT governance (table B4) that have been evaluated.

5. CONCLUSIONS

The present study analyzed the relationships between three well-known governance mechanisms and the effectiveness of IT governance in Brazilian federal public institutions. Empirical evidence shows that the performance of the IT Steering Committee and of the IT Solution Manager has a positive influence and considerably affects the performance of the IT Investment Portfolio Process. It also shows that these three mechanisms have a positive influence on the effectiveness of IT governance. The influence of the IT Investment Portfolio Process is direct, quite high, statistically significant and easily detected by means of a simple regression analysis. The direct influences of the IT Steering Committee and of the IT Solution Managers on IT governance effectiveness were not proven at statistically significant levels. Nevertheless, the use of a more robust statistical analysis allowed us to detect statistically significant total effects of these two mechanisms on the effectiveness of IT governance, when the IT Investment Portfolio was considered as a mediator. This suggests that, in order to be effective, efforts to improve the performance of the IT Steering Committee or of IT Solution Managers depend on the existence of the IT Investment Portfolio Process. It should be highlighted that the need to use the mediation analysis technique must not be interpreted as some type of weakness in the effects observed: it only indicates that the mechanisms analyzed interact in a more complex way, thus also requiring more sophisticated techniques for the appropriate analysis of their effects.

It also should be noted that the results of this study should not necessarily be interpreted as a causal relationship between variables, considering that the specific investigation techniques and statistical methods required for providing such evidence were not used (ideally, controlled experiments). Therefore, the terms “influence” and “effect” used in the study in order to facilitate describing the relationships between the governance mechanisms that were evaluated are better interpreted as a factual reflection of the value variations of a variable in relation to the values presented by another variable, irrespective of the identification of the primary cause of this phenomenon.

The performing of this study faced funding and time restrictions that resulted in certain limitations that must be considered when interpreting the results. First, the sample size may be considered limited, given the number of federal public organizations that exist in the country. Second, the disproportional number of respondents per institution may be considered small in some cases and quite large in others, as in the case of TCU, with possible effects on the values estimated by the statistical calculations, a consequence of the different levels of IT governance maturity encountered in the organizations. Third, the fact that the analyzed model did not take into account other IT governance mechanisms, which were intentional, in order to simplify the survey questionnaire and not to discourage respondent participation. However, the absence of other mechanisms implies that other relationships were not evaluated. We suggest that researchers with interest in further deepening the work done in this study may find ways of reducing the aforementioned limitations.

On the other hand, this study has innovated in some important aspects, such as taking into account the opinion of the respondents to assess the relevance of the questions, in addition to the measurement of their fulfillment and the application of the

questionnaire to a broad target audience. This audience represented several key IT stakeholders in public organizations, including directors, managers, internal clients and IT technical staff.

Remembering that IT governance is the responsibility of higher-level management, normally the board of directors (Weill & Ross, 2006; ABNT, 2009; BRASIL, 2010b; ISACA, 2012), the results of this study can be used as input for decision-making by public organization leaders regarding the implementation of the governance mechanisms analyzed. They may also support the organization's IT managers and IT governance staff in the identification of training needs and in the planning of communication and educational actions, based on the conclusions presented in Figure 3 – regarding the hypotheses tested based on the conceptual model of Figure 1 – as well as based on the other findings related to the differences in perceptions between groups, as detailed in Appendix B.

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APPENDIX A – Formulated questions and research variables

1. Questions about the IT investment portfolio management process (PROCPORTF):

1.1 The selection and prioritization of proposals for new IT solutions are based on clear and transparent criteria, previously known to all parties involved.

1.2 The selection and prioritization of proposals for new IT solutions take into account the strategic, financial, pro-improved performance and informational benefits that can be generated by each IT solution for the business.

1.3 The selection and prioritization of proposals for new IT solutions take into account the costs related to financial disbursements and the costs associated to their own personnel allocated to develop or contract, support and operate the IT solution, estimated both for the project phase, as well as for the operation phase.

1.4 The analyses associated to the benefits, costs and risks of new IT solutions are recorded/documented, in order to provide input for the monitoring of these elements during the project phase, as well as during the solution's operation phase.

1.5 The responsibilities of the IT area, of the demanding (interested) unit and of the IT steering committee or equivalent body regarding the selection/prioritization stage, as well as the operation and support stage of IT solutions, are well defined.

2. Questions about the IT Steering Committee or equivalent structure (COMITE):

2.1 The organization counts on one (or more) IT steering committee or equivalent structure with representatives from business units that engage in the institution's governance and IT management.

2.2 The representatives of business units in the IT steering committee are heads of organizational units and not advisors or middle-management staff.

2.3 The IT steering committee decides (or is always consulted) on the selection and prioritization of IT projects/initiatives aimed at promoting new IT solutions.

2.4 The IT steering committee follows up/monitors the fulfillment of benefits, costs and risks of the most important IT solutions, during the project phase and during the operation and support phase.

3. Questions about IT solution managers or equivalent mechanism (GESTSOL):

3.1 There is a clearly defined management unit for each one of the IT solutions considered relevant or essential for the institution.

3.2 The IT solution management unit preferably is the owner of the business process affected by the solution or is the demanding unit or is the unit most interested in the solution.

3.3 The management unit defines the functional, non-functional and security requirements of the IT area, as well as the business rules of the IT solution.

3.4 The managing unit, together with the IT area, defines the service levels for the IT solution and monitors their fulfillment for as long as the solution remains in operation.

3.5 The managing unit monitors the fulfillment of benefits, costs and risks during the operation phase of the IT solution.

4. Questions about satisfaction towards IT governance and management (EFETGOVTI):

4.1 The managers of internal units, IT area clients, and other stakeholders are satisfied with the selection and prioritization method for new IT solutions.

4.2 Internal clients and other stakeholders are satisfied with the number of demands per new IT system/solution that have still NOT been met by the IT area (pending requests or backlog).

4.3 Internal clients and other stakeholders are satisfied with the swiftness (deadlines) agreed upon and effectively fulfilled by the IT area for the delivery of new IT solutions.

4.4 Internal clients and other stakeholders are satisfied with the costs agreed upon and effectively fulfilled by the IT area for the delivery of new IT solutions.

4.5 Internal clients and other stakeholders are satisfied with the quality and the level of service presented by the IT solutions currently in operation.

4.6 Internal clients and other stakeholders are satisfied with the fulfillment of strategic, financial, performance improvement and information benefits provided by IT solutions.

APPENDIX B – Other properties of the sample

| Group | Qty | Average | Standard deviation | “p” value (bilateral) |
|-------------------------------------|-----|---------|--------------------|-----------------------|
| <i>Respondents from other inst.</i> | 117 | 9.2 | 1.1 | 0.553 |
| <i>TCU respondents</i> | 72 | 9.1 | 1.0 | |
| <i>Managers</i> | 92 | 9.2 | 1.0 | 0.551 |
| <i>Non-managers</i> | 97 | 9.1 | 1.1 | |
| <i>With IT Gov. course</i> | 131 | 9.4 | 0.8 | 0.036 |
| <i>Without IT Gov. course</i> | 58 | 8.8 | 1.5 | |
| <i>IT personnel</i> | 151 | 9.1 | 1.1 | 0.088 |
| <i>IT area clients</i> | 38 | 9.4 | 0.9 | |
| <i>IT auditors/consultants</i> | 84 | 9.3 | 0.9 | 0.070 |
| <i>Non IT auditors/consultants</i> | 105 | 9.1 | 1.2 | |

Obs.: Because it refers to a non-normal, right-tailed, negative-skewed distribution, the Wilcoxon-Mann-Whitney hypothesis test was used in substitution of Student’s t-test.

The hypotheses tested are:

H0: The difference in the position between the two samples/groups is equal to 0.

H1: The difference in the position between the two samples/groups is different from 0

Table B1 – Perception of groups regarding the importance of the IT Portfolio Process

| Group | Qty | Average | Standard deviation | "p" value (bilateral) |
|-------------------------------------|-----|---------|--------------------|-----------------------|
| <i>Respondents from other inst.</i> | 117 | 9.0 | 1.3 | 0.036 |
| <i>TCU respondents</i> | 72 | 8.8 | 1.1 | |
| <i>Managers</i> | 92 | 9.0 | 1.1 | 0.520 |
| <i>Non-managers</i> | 97 | 8.9 | 1.3 | |
| <i>With course on IT Gov.</i> | 131 | 9.1 | 1.0 | 0.050 |
| <i>Without course on IT Gov.</i> | 58 | 8.6 | 1.5 | |
| <i>IT area personnel</i> | 151 | 9.0 | 1.2 | 0.387 |
| <i>IT area client personnel</i> | 38 | 8.9 | 1.1 | |
| <i>IT auditors/consultants</i> | 84 | 9.2 | 0.9 | 0.004 |
| <i>Non-IT auditors/consultants</i> | 105 | 8.7 | 1.3 | |

Obs.: Because it refers to a non-normal, right-tailed, negative-skewed distribution, the Wilcoxon-Mann-Whitney hypothesis test was used in substitution of Student's t-test.

The hypotheses tested are:

H0: The difference in the position between the two samples/groups is equal to 0.

H1: The difference in the position between the two samples/groups is different from 0

Table B2 – Perception of groups regarding the importance of the IT Steering Committee

| Group | Qty | Average | Standard deviation | "p" value (bilateral) |
|-------------------------------------|-----|---------|--------------------|-----------------------|
| <i>Respondents from other inst.</i> | 117 | 9.0 | 1.2 | 0.218 |
| <i>TCU respondents</i> | 72 | 8.9 | 1.0 | |
| <i>Managers</i> | 92 | 9.1 | 0.9 | 0.428 |
| <i>Non-managers</i> | 97 | 8.9 | 1.2 | |
| <i>With course on IT Gov.</i> | 131 | 9.1 | 0.8 | 0.038 |
| <i>Without course on IT Gov.</i> | 58 | 8.7 | 1.4 | |
| <i>IT area personnel</i> | 151 | 9.0 | 1.1 | 0.496 |
| <i>IT area client personnel</i> | 38 | 9.0 | 0.9 | |
| <i>IT auditors/consultants</i> | 84 | 9.3 | 0.8 | 0.006 |
| <i>Non-IT auditors/consultants</i> | 105 | 8.8 | 1.2 | |

Obs.: Because it refers to a non-normal, right-tailed, negative-skewed distribution, the Wilcoxon-Mann-Whitney hypothesis test was used in substitution of Student's t-test.

The hypotheses tested are:

H0: The difference in the position between the two samples/groups is equal to 0.

H1: The difference in the position between the two samples/groups is different from 0

Table B3 - Perception of groups regarding the importance of the IT Solution Manager

| Group | Cause 1 | Cause 2 | Cause 3 | Cause 4 | Cause 5 | Cause 6 |
|----------------------------------|------------|------------|------------|------------|------------|------------|
| <i>TCU respondents</i> | 56% | 24% | 69% | 8% | 53% | 40% |
| <i>Respondents from other</i> | 80% | 46% | 83% | 43% | 52% | 57% |
| <i>Managers</i> | 76% | 39% | 76% | 35% | 52% | 49% |
| <i>Non-managers</i> | 67% | 38% | 80% | 26% | 53% | 52% |
| <i>With course on IT Gov.</i> | 72% | 39% | 81% | 33% | 52% | 51% |
| <i>Without course on IT Gov.</i> | 71% | 37% | 71% | 25% | 54% | 50% |
| <i>IT area personnel</i> | 79% | 45% | 79% | 34% | 47% | 55% |
| <i>IT area client personnel</i> | 42% | 9% | 76% | 18% | 76% | 33% |
| <i>IT auditors/consultants</i> | 68% | 39% | 78% | 41% | 48% | 50% |
| <i>Non-IT</i> | 75% | 38% | 78% | 22% | 57% | 52% |

Cause 1: Insufficient IT personnel

Cause 2: Lack of technical training by IT personnel

Cause 3: Lack of or shortcomings in IT governance and management processes

Cause 4: Insufficient financial/budgetary resources

Cause 5: Alternatives regarding the provision of IT solutions are not sufficiently exploited (ex: in-house vs. outsourced development)

Cause 6: Shortcomings in management skills training for IT personnel

Obs: Respondents were allowed to select multiple causes or none of these causes; therefore, the variation possible for each of the causes is 0 to 100% for each stakeholder group.

Table B4 – Perception of groups regarding the main causes of non-effectiveness of IT Governance