A DEVELOPMENT MODEL FOR E-GOVERNMENT BASED ON ICT GOVERNANCE CONCEPTS

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ABSTRACT

The quality of government is a global concern, government administrations should act in accordance with the principles of the common good, transparency and agility. E-Gov is the use of Information and Communication Technology (ICT) to improve access and delivery of information, providing services to citizens, business partners, employees and other government entities. There are some models to help governments to make good use of ICT, but they do not provide a clear guide of how governments can improve their e-gov processes. This paper proposes a new model for e-gov development, aligned with ICT governance concepts and practices. This model provides a guide to government agencies to develop actions to improve their processes.

KEYWORDS

e-gov; e-governance; maturity model; improvement; assessment

1. INTRODUCTION

A major challenge for many enterprises, including governments, is the poor alignment between businesses and ICT. This lack may be addressed by ICT governance. The use of ICT by organizations is a critical success factor and it can be applied across the organization. The application of ICT in government is called E-government (e-gov) and must be driven by the government objectives. Consequently, the e-gov development must be supported by ICT governance.

In recent years, many government agencies have made significant investments in hardware, software and network infrastructure to address some of their problems using ICT. However, they have not invested in IT service management and ICT governance. They have acquired many ICT solutions, but they do not know how to put them to work together in benefit of their strategic goals. In some scenarios, introduction of new technologies without proper preparation and management might make the government agencies problems even worse, instead of helping to solve them.

According to Savoldelli et al. (2014), e-gov should provide high quality services and delivery processes to produce meaningful and needed information. Hence, e-gov is used to improve access and delivery of government information by providing services to citizens, society, business partners, employees and other government units. E-gov can help building a better relationship between governments and society, making their interaction easier and more effective (Layne et al., 2001).

According to Meijer and Bekkers (2014), there is a crucial question that must be addressed, which is, how do the new technologies transform our social construction of government? It can also be interpreted as, how do the new technologies transform the government? In their study, Savoldelli et al. (2014) identified that institutional and political barriers are two of the main factors explaining the lack of e-gov adoption.

The present work has the objective of creating an e-gov model to detect weaknesses and improvements in development of e-gov. This model is based on ICT governance and can help the government to extract more value of new technologies and practices to offer adequate services.

This work proposes a new method to assess the current level of a government unit and drive improvements to reach its desired level. Therefore, the proposed model must meet the following requirements:

- To allow the government unit to identify its current ICT governance level;
- To allow the government unit to compare itself with other government units that were analyzed by the same model;
- To suggest feasible roadmaps that can be used to improve the government ICT governance level.

In this paper, we will understand the relationship between ICT governance and e-gov and how they are complementary. In Section 2, we present related work of ICT governance and e-gov and their main concepts. In Section 3, we explain the new proposed model and how it works. Section 4 presents the application of the proposed model and shows how it can help to develop e-gov from ICT governance. Finally, in Section 5, we discuss the results and suggest future work.

2. RELATED WORK

Gartner Inc. defines ICT governance as the processes that ensure "the effective and efficient use of ICT in enabling an organization to achieve its goals" (Gartner 2014). These main processes are (Gartner 2012): setting decision rights and resulting policies; establishing measures to monitor adherence to decision and policies; ensuring that processes and procedures are in accordance with policies and with tolerance support decisions; and balancing investments in accordance with policies and in support of objectives.

Another key concept is e-gov. According to Sprecher (2001), it includes all technology used to simplify and automate transactions of government to citizens, business and other government. As ICT governance is needed to provide strategic alignment between business and ICT, it is necessary to guide the e-gov development according to business needs.

Lee et al. (2005) shows a classification of several kinds of e-gov applications according to their end users, such as, Government to Citizen (G2C), Government to Business (G2B), Government to Government (G2G), Internal Efficiency and Effectiveness (IEE) or Government to Employee (G2E), and finally Overarching Architecture.

Based on this classification, Lee et al. (2005) proposed a progressive model to help government managers to develop e-gov in their units. This model consists of four stages, as follows: 1 – Catalogue, 2 – Transaction, 3 – Vertical Integration and 4 – Horizontal Integration. This model does not consider ICT governance.

Iribarren et al. (2008) also proposed an e-gov maturity model, which is organized in five maturity levels. The needed score to reach each level is changed according to the government strategy. A final model was established with four domains (e-Gov Strategy, ICT Governance, Process Management, and Organization and People Capabilities), 17 domain keys and 54 critical variables. This model was applied in 30 government units and discussed by Valdés et al. (2011).

Although the model of Iribarren et al. (2008) considers the ICT governance, it is not clear in this work how a government agency can develop its e-gov services and processes based on its ICT governance.

Damian et al. (2010) performed a SWOT analysis in 50% of Brazilian e-gov services and concluded that information architecture is needed to improve the quality of information and interaction with users. This study matches with the set of municipal administration evaluated and will be used to identify the effects of ICT governance on e-gov services.

All analyzed e-gov models do not have a practical approach to guide their application. Although they are good references for e-gov development, it is not clear how public administration can use them to improve the e-gov quality. Our model proposes a practical approach based on ICT governance to address this gap. It was developed to offer a clear guide for e-gov processes improvement.

3. E-GOVERNMENT MODEL

To create the new model, we related the existing ICT governance and e-gov concepts presented by Gartner Inc. (2012, 2014) and Sprecher (2001). In this sense, ICT governance scope comprises the internal ICT processes and procedures and may be affected by external relationship such as G2C, G2B, G2G and G2E. Moreover, e-gov scope embraces all the above mentioned external relationships. Figure 1 shows the relationship between e-gov and ICT governance.

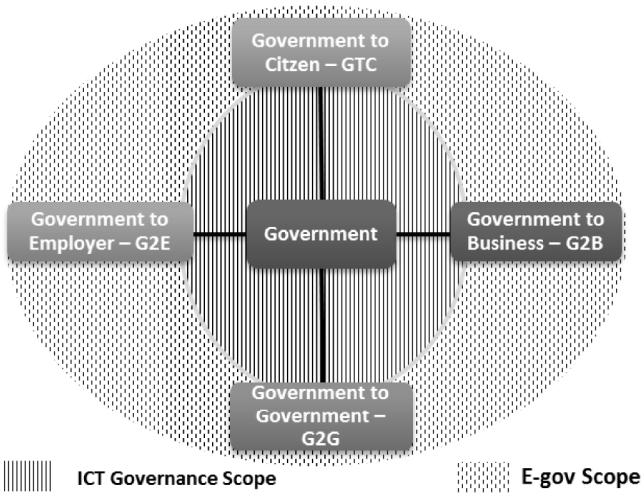

Figure 1. ICT governance and E-gov scope.

Considering that e-gov consists of all the technology used to support the government, and ICT governance consists of internal processes, structures, and mechanisms that organize the decision making process and guiding the government actions. Analyzing Figure 1 we can identify some concepts, such as:

- E-gov must consider the ICT governance to be implemented according to government objectives;
- E-gov is broader than ICT governance;
- Without good ICT governance, developing a good e-gov platform is difficult.

According to the concepts previously identified, we find that the simple adoption of e-gov concepts and tools does not necessarily solve the problems of the government. Often, it makes the problems more complex and difficult to solve. Hence, it is very important that the ICT governance drives the e-gov strategy and implementation.

To address this fact, our model must start from ICT governance, so we used an ICT governance development framework. The proposed model was derived from an existing framework to develop ICT governance in organizations from Briganó (2012). The entire proposed model is based in six axes. These axes are used to calculate and score the current situation and identify improvements of each axis. Table 1 shows the axes.

Table 1. E-gov model axes.

Name	Description
Strategic Align (SA)	Relationship between business strategic plans and actions, and ICT plans and actions.
Value of ICT (VICT)	Delivery of the ICT benefits planned at business strategy and optimization of costs.
Risk Management (RM)	Identify, analyse, measure and control the ICT related risks.
ICT Resources (ICTR)	Optimization of use or ICT resources
Performance (PER)	Definition and control of measures and performance of ICT
Responsibilities (RESP)	Cleary defined responsibility of the decisions, structures, and mechanisms of ICT.

These axes showed in Table 1 are independent from each other but correlated. It means that a single axis can be improved without affecting the other axes negatively; the other axes can just be affected positively.

The model consists of an evaluation method and a knowledge base that is used to drive improvement actions. The evaluation method is composed by a survey and a calculation engine. The survey relates daily facts to scores and its objective is to be easily answered by an IT professional. Each question in the survey has a relationship value with each axis. This value is affected by the possible alternatives of each question. Table 2 shows a question sample.

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Table 2. Question sample.

Do the existing ICT services in the organization meet the needs of its users and their changes?					
Relationship with axes					
AS	4	RM	0	PER	1
VICT	2	ICTR	0	RESP	0
Alternatives					Impact
a) Yes, all services meet the needs of their users and keep up to date with them.					3
b) New services met the needs, but did not follow the changes.					1
c) Some services meet the needs and others are insufficient.					-2
d) It is not known if the services are sufficient or not for its users.					-3

In Table 2 the scale used to score the question with the axes is 0 to 6, and the scale used to identify the impact of the answer is -3 to +3. The calculation engine uses the answers from the survey to obtain the score of each axis by adding the values of the questions for each axis according to the selected alternatives. The model also has six steps that guide its application from the information collection to the development of improvement actions. Figure 2 shows the model workflow.

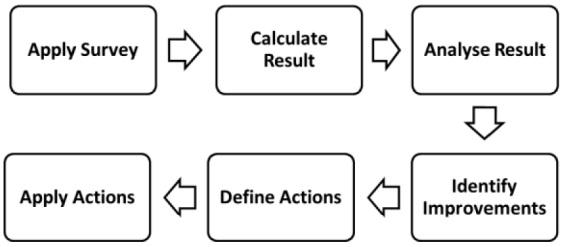

Figure 2. E-gov model workflow.

All steps showed in Figure 2 are based on the six axes (Table 1) and the relationship between the axes and the steps is as follows:

- *Apply Survey*: Consists of the application of the survey in the organization to obtain information about how ICT department works. To answer the questions, an ICT professional with a holistic view of the government agency is required. The axes are transparent to questions answers, but are considered to the development of it;
- *Calculate Result*: This step consists in the calculation of the result based on the answers obtained from the survey application. The result is presented according to the axes. The value of each axis is given by the sum of the point of question at the axis multiplied by the impact of the answer;
- *Analyze Result:* At this step, an analysis is realized to understand the ICT at the organization. This analysis is based on the answers and information about the organization;
- *Identify Improvements:* With analysis information, improvements at each axis can be identified and their value estimated. After that, improvements are prioritized;
- *Define Actions:* Actions to implement the prioritized improvements are identified and defined. These actions are based in a repository of actions and in the COBIT Framework (ISACA 2013). This repository includes possible solutions that can be used to implement the improvements organized by the axes;
- *Apply Actions:* The actions must be applied according to the prioritization and then evaluated. The evaluation result must be registered at the repository.

After these six steps, the government will be able to implement actions that will improve its internal ICT according to the identified weaknesses. This model can be applied interactively, fostering continuous improvement.

4. MODEL VALIDATION

To validate the model, we applied it in five municipal administrations (MA) of Brazil (rank 57 of 193 in E-Government Development Index), analyzed the results, and identified how the model can help each one. To do this, we consider three attributes to describe each MA. The first of them is the positioning of ICT.

Rodrigues et al. (2009) explains that ICT can be classified at three levels in an organization, as shown in Figure 3, and this affects how ICT governance works in the organizations.

Figure 3. Positioning of ICT.

As shown in Figure 3, the three possible ICT positions are: Operational ICT, meaning that ICT is focused on providing services and resources to maintain the ICT infrastructure and information; tactical ICT means that ICT is aligned with management level and is focused on optimizing risks, costs and value; Strategic ICT means that ICT is directly engaged to strategic board and can influence and transform the business. The ICT positioning attribute adapted for MA is described below:

- *Operational ICT*: Municipal administration has a team of ICT with a coordinator that does not have influence outside the team. This team just receives demands and delivery services.
- *Tactical ICT:* Municipal administration has an ICT sector with a manager that is subordinated to a government department. The manager affects the government department, but does not have any influence outside of it. The ICT sector is involved in some strategic decisions.
- *Strategic ICT*: Municipal administration has an ICT department that is subordinated to the steering board. The ICT department affects all the other government departments and is always involved in the strategic decisions.

To define the ICT positioning of an MA, we consider the description of each position showed previously and analyzed the organization chart to find one that best fits. We also consider two more attributes, the revenue and population of each city, to describe the set of MA. To define the values of this attributes, we seek on the websites of each city. Names of the cities were not displayed due to the request of their administrations. The MAs description is shown in Table 3.

Table 3. Municipal administrations attributes.

	Population (2014)	**Revenue (2014)**	**IT Position**
MA 1	5,227.00*	U$ 4,950,148.91*	Operational
MA 2	23,542.00*	U$ 16,513,944.78*	Operational
MA 3	51,802.00*	U$ 32.639.701.78*	Strategic
MA 4	25,855.00*	U$ 19,172,998.74*	Operational
MA 5	543,003.00*	U$ 291,812,182.26*	Tactic

*extracted from cities' website

All selected MA have e-gov initiatives such as a Citizen's Portal with government information. To apply the proposed model, we selected the ICT professional with more power at the organization. The survey was answered by the professional.

Secondly, we calculated the result of the survey for axes with the evaluation method. This method gives the score of each axis represented in a radar plot, as shown in Figure 4.

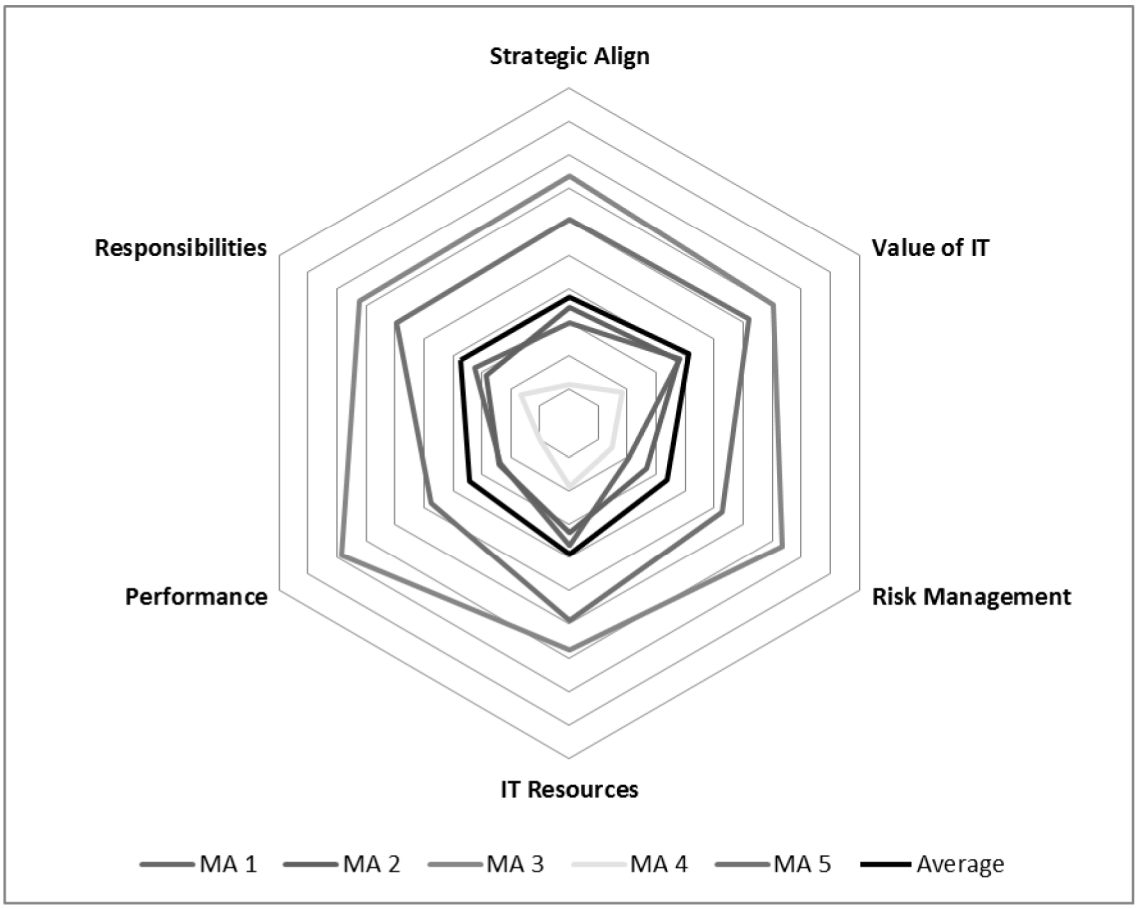

Figure 4. Results from the survey application.

With these results showed in Figure 4, and context information of MA, it was possible to define, compare and analyze the ICT governance situation between the MAs. To compare the results obtained in the MAs, we investigate all the responses and identify the points of disagreement. Therefore we investigated these points and found their root. The analysis of each axis is showed in the following subsections.

4.1 Strategic Alignment

First, we analyzed the results for Strategic Alignment. The average score of this axis was 37.29%, as the main objective of ICT governance is strategic alignment, it must drive the actions of MAs and it is a key factor for success on ICT use. Table 4 shows the results obtained for this axis.

Table 4. Results for Strategic Alignment axis.

MA 1	MA 2	MA 3	MA 4	MA 5	Average
29.72%	34.31%	73.76%	11.38%	60.92%	37.29%

The result was independent from MA size or revenue and the attribute that more affected the strategic alignment was the positioning of ICT (Figure 3). According to the Table 4, MA 3 (classified as strategic ICT) scored 73.76% followed by the MA 5 (classified as tactical ICT) that scored 60.92%, a difference of 12.84 perceptual points (pp). All MAs classified as operational ICT scored less than 35%, with minimum difference of 26.61pp from the MA 3. With a deep analysis of the results, we had some findings that promoted the strategic alignment for these evaluated MAs, as follows:

- ICT is able to demonstrate the value obtained by technologies' use;
- ICT decisions are made by a committee that includes ICT and other areas of organization;
- A strategic plan is defined by the organization and ICT actions are based on this plan and reviewed when needed;
- ICT investments are justified by strategic goals;
- Enterprise architecture is defined based on strategic plans;
- ICT projects were frequently reviewed;
- ICT factors are frequently considered to the strategic discussion.

4.2 Value of ICT

The average score we found for value of ICT was 41.16%. In this axis, the result is also independent from city size or revenue. The only factor that affects this axis is the positioning of ICT at the organization. Table 5 shows the results of this axis.

Table 5. Results for value of ICT axis.

MA 1	MA 2	MA 3	MA 4	MA 5	Average
38.19%	37.62%	70.44%	18.39%	61.95%	41.16%

According to the Table 5, the MA 3 scores more than others (70.44%) followed by MA 5 (61.95%), a difference of 8.49pp. All the others MAs score less than 40%, with minimum difference of 23.76pp from the MA 3. We found some facts that favored the Value of ICT in the MA set evaluated, they are presented as follows

- ICT is able to demonstrate the value obtained by technologies' use;
- All ICT incidents and requests are registered and are available for analysis;
- ICT decisions are made by a committee that includes ICT department and other areas of organization;
- A strategic plan is defined by the organization and ICT actions are based on this plan and reviewed when needed;
- ICT investments are justified by strategic goals;
- Enterprise architecture is defined to reach the strategic goals;
- ICT projects were frequently reviewed and the knowledge is shared;
- There are training about using ICT as necessary;
- ICT factors are frequently considered to the strategic discussion;
- The processes are reviewed before automation.

4.3 Risk Management

The proposed model does not evaluate specific risk management practices at organizations. It verifies some generic practices that indicate whether there are risk and mechanisms to avoid or treat them. This axis is not affected by city revenue or population. Table 6 shows the results found at each municipal administration for the Risk Management axis.

Table 6. Results for Risk Management axis.

MA 1	MA 2	MA 3	MA 4	MA 5	Average
20.35%	26.55%	73.45%	14.60%	52.65%	33.74%

According to Table 6, the two municipal administrations that most scored were MA 3 and MA 5, which have ICT position as Strategic and Tactical respectively, with a difference of 20.80pp. The average founded was 33.74%, and the difference between ICT tactical and operational was 26.10pp. Some factors that positively affected the Risk Management at the evaluated set of MA are showed below.

- Standards and criteria are defined to organize and categorize issues;
- Complete and formal business cases are required for investments, considering risks analysis;
- ICT projects were frequently reviewed and the knowledge is shared;
- The processes are reviewed before automation.

4.4 ICT Resources

This axis evaluates how the use of ICT resources is optimized. It considers the use of some consolidated technologies and practices that are frequently used to optimize the use of ICT resources. Table 7 shows the values obtained for this axis.

Table 7. Results for ICT Resources axis.

MA 1	MA 2	MA 3	MA 4	MA 5	Average
36.35%	32.67%	67.64%	18.87%	58.74%	38.88%

According to Table 7, the average for this axis is 38.88% and the municipal administrations with the highest scores were MA 3 and MA 5. MA 3 was classified as ICT strategic and MA 3 was classified as ICT Tactical with a difference of 8.90pp between them. The highest score among the ICT operational municipal administration was 22.39pp lower than the MA 5. As we observed in other axes, the city revenue and population did not affect this axis; the internal ICT positioning affected it. Some issues that promoted the ICT resources in the evaluated set of MAs are showed below.

- ICT is able to demonstrate the results obtained with technologies' use;
- An exclusive point of contact of ICT is established;
- All ICT incidents and requests are registered and are available for analysis;
- Virtualization of servers is used in a systematic way;
- A backup policy is defined and applied. Backups are tested, validated and stored in a safe site;
- A strategic plan is defined by the organization and ICT actions are based on it and reviewed when needed;
- ICT investments are justified by strategic goals;
- Enterprise architecture is defined to reach the strategic goals;
- Complete and formal business cases are required for investments, considering risks analysis;
- There are training about using ICT as necessary;
- Specific guidelines for ICT projects are defined and used;
- The ICT users have a good knowledge and are able to use ICT applications;
- The processes are reviewed before automation;
- The user support of the organization is effective, helpful and solves problems on time.

4.5 Performance

In this axis, we evaluated how the municipal administration uses the information to understand and improve the ICT performance. Table 8 shows the values obtained for this axis.

Table 8. Results for Performance axis.

MA 1	MA 2	MA 3	MA 4	MA 5	Average
23.81%	24.29%	78.57%	10.00%	47.62%	34.17%

The average showed at Table 8 is 34.17% and, as the other axes, the municipal administrations with the highest scores were MA 3 (ICT Strategic) and MA 5 (ICT Tactical), with difference of 30.95pp between them. The highest score among the ICT operational municipal administration was 23.33pp lower than the MA 5. In this case, we also observed that the internal ICT position affected this axis. Some factors that favored the Performance in the evaluated set of MA:

- All ICT issues are registered and are available for analysis;
- Standards and criteria are defined to organize and categorize issues;
- The records an issues are analyzed to review the services;
- Criteria for integration and standardization of ICT are well defined;
- There are adequate organizational indicators that are shared with employees.

4.6 Responsibilities

The last axis we analyzed was responsibilities. In this axis, we evaluated how the municipal administration defined, delegated and communicated ICT responsibilities. Table 9 shows the values obtained for this axis.

Table 9. Results for Responsibilities axis.

MA 1	MA 2	MA 3	MA 4	MA 5	Average
32.56%	28.57%	72.43%	16.61%	59.47%	37.54%

The average showed in Table 9 was 37.54% and, as the other axes, the municipal administrations with the highest scores were MA 3 (ICT Strategic) and MA 5 (ICT Tactical), with difference of 12.96pp between them. The highest score among the ICT operational municipal administration was 26.91pp lower than the MA 5. As the other axes, the internal ICT positioning was the only attribute of municipal administration that affected this axis. Some factors that favored the Responsibilities in the evaluated set of MA:

- There is a way to support communications inside the organization;
- ICT decisions are made by a committee that includes ICT and other areas of the organization;
- Enterprise architecture is defined to reach the strategic goals;
- Complete and formal business cases are required for investments, considering risks analysis;
- Specific guidelines for ICT projects are defined and used;
- The responsibilities are clearly defined and communicated;
- Organizational roles and responsibilities are defined seeking to extract most value of ICT;
- ICT projects have an engaged and responsible executive;

With the analysis of the responses, we detected that two important issues were not addressed by any evaluated municipal administration. First, all municipal administrations reported communication problems. Second, no evaluated municipal administration had a well-defined responsibility plan. These issues, if addressed, could improve the communication inside the organization.

With the results from the application of ICT governance model, we were able to identify that the main factor influencing the ICT Governance in evaluated MAs is the positioning of the ICT. We use it to group the average of each ax. Then we related the groups between them. We found the difference of 15.82pp between strategic and tactic ICT and a 24.85pp difference between tactic and operational ICT, as shown in Table 10.

Table 10. Score difference.

	STRATEGIC TO TACTICAL	TACTICAL TO OPERATIONAL	STRATEGIC TO OPERATIONAL
Strategic Alignment	12.84pp	26.61pp	39.45pp
Value of IT	8.49pp	23.76pp	32.25pp
Risk Management	20.80pp	26.10pp	46.90pp
IT Resources	8.90pp	22.39pp	31.29pp
Performance	30.95pp	23.33pp	54.28pp
Responsibilities	12.96pp	26.91pp	39.87pp
Average	15.82pp	24.85pp	40.67pp

From the identified factors in each axis we compiled a set of issues that promoted the ICT governance. And we related these issues with the position of ICT that favor them. Table 11 shows the main issues found and the related ICT positioning of MA.

According to Table 11, we identify a relationship between ICT positioning and the number of issues found. The ICT operational is related to none of them, the ICT tactical is related to 16 issues and the ICT strategic is related to 23 issues. We identified that a good way to improve the ICT governance on the evaluated MA was to apply actions based on the issues found. So we related these issues and the actions to the responsible of each MA. These actions help the MA to improve their score on the model and consequently improve their ICT governance.

We merged the present results with the results presented by Damian et al. (2014). Consequently we were able to identify some issues that affected negatively the e-gov services quality and trusty such as 2, 3, 5, 4, 6, 7, 8, 11, 19, 20 and 21 presented in table 11. All these issues may be addressed by ICT governance, affecting the e-gov services and are addressed by ICT governance according to axis other identified issues also affected the e-gov indirectly.

Table 11. ICT positioning and issues mapping.

	Issues	OP	TC	ST
1	ICT is able to demonstrate the results obtained with technologies' use;		X	X
2	ICT decisions are made by a committee that includes ICT and other areas of the organization;		X	X
3	A strategic plan is defined by the organization and ICT actions are based on this plan and reviewed when needed;		X	X
4	ICT investments are justified by strategic goals;			X
5	Enterprise architecture is defined based on strategic plans;			X
6	ICT projects are frequently reviewed and the knowledge is shared;		X	X
7	ICT factors are frequently considered to the strategic discussion;		X	X
8	All ICT issues are registered and available for analysis;		X	X
9	There are trainings about use of ICT as necessary;		X	X
10	Business processes are reviewed before automate;		X	X
11	Standards and criteria are defined to organize and categorize issues;		X	X
12	Complete and formal business cases are required for investments, considering risks analysis;		X	X
13	An exclusive point of contact of ICT is established;			X
14	Virtualization of the servers is used in a systematic way;			X
15	A backup policy is defined and applied. Backups are tested, validated and stored in a safe site;			X
16	There are specific guidelines for ICT projects;			X
17	The ICT users have a good knowledge and are able to use ICT applications correctly;		X	X
18	The user support of the organization is good, helpful and solves problems on time;			X
19	Criteria for integration and standardization of ICT are defined;			X
20	There are adequate organizational indicators that are shared with employees;		X	X
21	The responsibilities are clearly defined and communicated;		X	X
22	Organizational roles and responsibilities are defined seeking extract most value of ICT;		X	X
23	ICT projects do not have an engaged and responsible executive;		X	X
24	The communication is effective;			
25	There is well-defined responsibility plan;			

5. CONCLUSION

The presented study aims to propose a new model to development of e-gov from ICT governance. With the application of ICT governance assessment we identified that ICT positioning of municipal administration is a decisive factor to obtain better ICT governance and e-gov services.

We also identified that good e-gov services must be supported by practices and well defined internal processes, which are addressed by ICT governance. Consequently, the quality of e-gov services can be affected by ICT governance. This reinforces the importance of models based on internal organizational aspects more than technical aspects (Savoldelli et al 2014).

The model was adequate to assess and improve the ICT governance of Municipal Administrations and did not consider technical aspects only. Some adjustments in the terminology of the questions may be performed to help the government agencies to better understand and answer them.

We concluded that the ICT positioning at a government agency is the major factor of influence in the governance level. The more strategic is the IT, more IT Governance is enhanced. Although the city's population and revenue do not affect the ICT governance level, it is possible that they can affect the IT positioning. A city which has more revenue and population is able to develop its ICT to strategic due to a greater availability of funds and qualified manpower.

Although we believe that this model can be applied to a central government this study does not confirm this. Further work can apply the model to public organizations to evaluate it. Also, future work may be performed to expand the model in order to assess and improve e-gov services, government legal issues and to perform the evaluation of government agencies through different roles.

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