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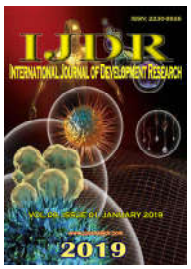

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

SMART CITIES AND IT GOVERNANCE: AN ANALYSIS OF THE BRAZILIAN FEDERAL GOVERNMENT PROJECT CALLED *MY SMART CITY*

***Rodrigo Franklin Frogeri, Daniel Jardim Pardini, Marta Macedo Kerr Pinheiro, and Denise Campos Chaves Machado**

Postgraduate Program in Information Systems and Knowledge Management, FUMEC University, Brazil

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ABSTRACT

This paper analyzes the application of IT Governance (ITG) principles in 282 Brazilian cities participating in the federal government project named "My Smart City". It will analyze the development of public policies from the Brazilian federal government towards its cities seeking to modernize the management and promote the development through the use of Information and Communication Technologies (ICTs). The methodological aspects of this study were based on documentary analysis of qualitative and quantitative nature, descriptive statistics, cluster and correlation techniques. The study showed that there is no ITG principles in most Brazilian cities, besides it also presents differences and inefficiency in the application of public policies towards ICTs. It is believed that the projects directed to the smart cities of Brazil can become a reality, once the plans of governance and management in ICTs are effectively applied within the cities and there are efforts for an integration among the indicators which compose a smart city.

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INTRODUCTION

Urban centers are characterized by complex systems that interconnect people, organizations, means of transportation, natural resources, security and public services (Neirotti, Marco, Cagliano, Mangano, &Scorrano, 2014). In this same environment it must coexist in harmony. On the other hand, rural exodus, high rates of population concentration in small territorial areas, increased fleets of vehicles that are disproportionate to the growth of public roads, social inequality, and other urban problems have been creating challenges for governments that should seek to innovative and sustainable solutions that provide better services to citizens (FGV PROJETOS, 2014; Weiss, Bernardes, &Consoni, 2015).The proposed solutions to the challenges ahead are based on the intensive use and application of Information and Communication Technologies (ICTs) as a means to ensure that cities are sustained (Caragliu, Del Bo, & Nijkamp, 2011). Technological innovations demonstrate the potential creativeand disruptive power of ICTs, and they can transform cities through integrative and constitutive technologies, towards urban sustainability (Komninos, Schaffers, &Pallot, 2011; Neirotti *et al*., 2014; FGV PROJETOS, 2014; Elias & Krogstie, 2017).Since 2000 (BRAZIL, 2015), Brazilian State, aiming to adapt itself to this new scenario, has developed public policies aiming maximizing the use and application of ICTs in Brazilian cities (FNDE, 2007; BRASIL, 2008, 2012). In 2016, Decree 8776 of May 11th, from the Brazilian Ministry of Science, Technology, Innovations and Communications presented the project "My Smart City", being an integral part of the Brazil Intelligent Program (DOU, 2016, p.150). The actions established in the program announcement focus on the implementation of ICT resources in the municipalities adhering to the project, conditioning the participating cities to minimum ICT infrastructure criteria and the existence of a municipal governance body (DOU, 2016, p.150).In the same sense that the policies for the development and use of ICTs in public agencies were created, the State started to demand a plan aligned with the strategies of each government body for the acquisition of ICT resources, in order to establish principles of IT Governance (ITG). Cepik and Canabarro (2014) point out that the fundamental tool for the adequacy of public administration to the challenges of the fourth technological revolution is IT (FGV PROJETOS, 2014).

****Corresponding author:*** **Rodrigo Franklin Frogeri**
Postgraduate Program in Information Systems and Knowledge Management, FUMEC University, Brazil

It is not just management tool, but it is also governance tool. Thus, the purpose of this study is to analyze the application of ITG principles in the Brazilian cities participating in the federal government's "My Smart City" project. It will investigate the development of public policies from the Brazilian federal government towards its modernization and the management of the development through the use of Information and Communication Technologies (ICTs).

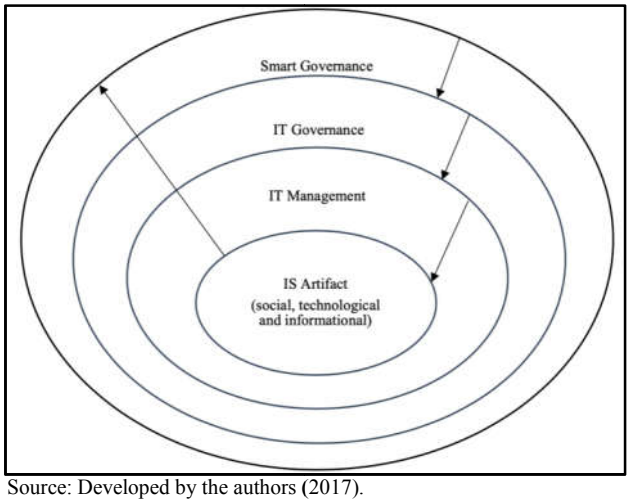
THEORETICAL REFERENCE

Smart Cities: The smart cities' theme has been the subject of discussions by the scientific community for some time, but it is still an abstract image, lacking conceptual precision (Hollands, 2008, Kobayashi, Kniess, Serra, Ferraz, & Ruiz, 2017). In this sense, several authors seek to define domains that comprise a smart city or even propose a redefinition of the term for a broader approach, such as "smart and sustainable cities", considering that a smart city is also sustainable, using ICTs, (Höjer&Wangel, 2014; Ahvenniemi, Huovila, Pinto-Seppa, &Airaksinen, 2017).Other perspectives seek to elucidate the differences between smart cities and digital cities, based on the assumption that an intelligent system is associated with a digital system (Jucevicius, Patašiene, & Patašius, 2014). It can be said that a smart city should also be a digital city. (Komninos*et al*., 2011; Silva, Leite, & Kerr Pinheiro, 2016). However, an intelligent system must be endowed with infrastructure, human capital and information, with a digital dimension capable of generating knowledge (Caragliu*et al*., 2011; Komninos*et al*., 2011; Jucevicius *et al*., 2014).

Ahvenniemi *et al*., (2017) analyzed the concept of smart cities from the point of view of sustainable smart cities, defining ten sectors (environment, urbanization, water and waste management, transport, energy, economy, education-culture-science health and safety, governance and citizen involvement, and information and communication technologies) and three categories of impact (environmental, economic and social sustainability), aiming to guide decision-making and evaluating the development of actions related to design a smart and sustainable city.Navarro, Ruiz, & Peña (2017), aiming to evaluate the influence of ICT in a smart city, established the following dimensions: (i) social / human capital; (ii) process capital (infrastructure, mobility and accessibility); (iii) commercial capital (strategies to encourage the use of ICTs); (iv) image capital (tourism, culture and quality of life); (v) capital R & D (creative and high technology industries applied to urban growth); (vi) environmental capital (sustainable management of the environment).Giffinger (2007) and Cohehen (2013) in relation to the indicators of a smart city (economy, people, governance, mobility, environment and quality of life) and their respective indicators (total 74). The authors pointed out that digital indicators have not dominated any of the indicators that characterize a smart city, but they are important to all of them.Applying the concepts of Hollands (2008), Neirotti *et al*., (2014), Zhuhadar Thrasher, Marklin, &Pablos, (2017), Bibri & Krogstie (2017) and Navarro *et al*., (2017), it was observed that cities are smart when they appropriate their own information and knowledge to improve the quality of life, social inclusion, environmental sustainability, economic competitiveness and the use of governance principles in the political decision-making process, without the need to have large technological devices.In the public arena, the ongoing fourth revolution (Micklethwait & Wooldridge, 2014) has been rethinking the state's attributions, with the main goal to improve the quality of health and education services through the use of technology. The discussion about the effectiveness of smart cities should be based on the results obtained with the resources, for example, artificial intelligence to enable remote health services, or even the efficient use of distance education devices. Factors related to the deficit structure of the State arising from the excessive expenditures on the public machine and the need to ensure the autonomy and sustainability of local authorities, such as City Halls and Municipal Councils, are basic pillars for the implementation of Information Technology governance that favors the promotion of smart cities.

Smart Governance and Information Technology Governance (ITG): Smart governance is based on ICTs and represented by a collection of technologies, people, policies, practices, resources, social norms and information that interact to support the city's governance activities (Chourabi *et al*., 2012). According to Meijer & Bolívar (2016, p.185), smart governance is "a matter of creating new forms of human collaboration through ICTs use for better results and more governance processes". This is a sociotechnical approach to governance by understanding an interaction between social, governmental and new technology structures (Viale Pereira, Cunha, Lampoltshammer, Parycek, & Testa, 2017). ICTs in Information Systems context are observed as an artifact composed of social, technological and informational elements (Chatterjee, Xiao, Elbanna, &Sarker, 2017; Lee, Thomas, & Baskerville, 2015).Under a relational aspect, ICTs support collaborative governance initiatives (Torfing, Peters, Pierre, &Sørensen, 2013) that must be directed by management and governance mechanisms to achieve intelligence in social, governmental and technological interactions (Scholl & Scholl, 2014).Smart governance practices require control and mechanisms that can support the demands for ICTs applications (Nam & Pardo, 2011), is discussed, in this sense, the IT governance (ITG). The main issues that delimit the ITG are associated with which IT decisions are to be addressed, which individuals should be given decision rights, and how these decision-making processes will be orchestrated to serve all stakeholders (Huang, Zmud, & Price, 2010). The figure 1 presents a relational view of smart governance and ITG. It defines as central element the IS artifact, which in turn is managed by management initiatives based on ITG mechanisms. Smart governance acts as an elements framework that interact among themselves to establish the ICTs demands.

Figure 1. Relational vision between smart governanceand ITG



Source: Developed by the authors (2017).

ITG mechanisms are high-level definitions applicable in organizations' everyday life to make ITG feasible (Bianchi, Sousa, Pereira, & Luciano, 2017; Wiedenhoft, Luciano, &Magnagnagno, 2017).Nfuka and Rusu (2011) suggest the composition of ITG in structures (functions and responsibilities, organizational structures), processes (market practices in IT management - COBIT, ITIL, among others) and relational mechanisms (active participation and collaboration among key stakeholders) (De Haes & Grembergen, 2004), which together can provide the alignment of city government activities with the IT practices (SI artifact) (Héroux & Fortin, 2017).Within the Federal Public Administration (APF), ITG is established by a central body called System Management of Information Technology Resources (SISP), but the bodies belonging to the APF develop, autonomously (Cepik, Canabarro, Possamai, &Sebben, 2014), their governance and IT management policies. The main regulation of ITG under the APF bodies was normative instruction IN / SLTI 04/2010, art. 4, obliging agencies and entities, which are members of the SISP, to have a planning for the acquisition of ICT goods and services. It is instituted by an Information Technology Master Plan (PDTI), aligned with the strategy of the body or entity (TCU, 2008, Brazil, 2011). A PDTI can be understood as "an instrument that allows guiding and monitoring the performance of an IT area, defining strategies and an action plan to implement them - it makes it possible to justify the resources applied in IT and minimize waste" (SISP, 2012, p.10). Following in the same direction as the Brazilian Court of Union Auditors (TCU), the São Paulo State Court of Auditors (TCESP) have created the Municipal Management Effectiveness Index (IEGM), and they were disseminated to all other Brazilians Auditors Courts. Brazilian IEGM is composed by seven sector indices and 143 indicator[1]: (i-EDUC) Education; (i-HEALTH) Health; (i-PLANNING) Planning; (i-FISCAL) Fiscal Management; (i-ENVIRONMENT) Environment; (i-CITY) Protected Cities / infrastructure; and (i-GOV IT) Governance in Information Technology.The objective of IEGM Brazil is to evaluate the effectiveness of public policies and activities developed in Brazilian Cities by its managers (IRBCONTAS, 2015).

MATERIALS AND METHODS

For this analysis, it was considered the data of the cities listed in IEGM Brazil 2015 (IRBCONTAS, 2015) that had index in i-GOV TI and the cities participating in the My Smart City project, available on the official site[2] of the project (352 cities). The IEGM Brazil index is based on the scale defined in Table 1.

Table 1. IEGM Scale

IEGMScale	Description	Criteria
A	Highly effective	IEGM at least 90% of the maximum rating and at least 5 components having A rate indices.
B+	Very effective	IEGM among 75.0% and 89.9% of the maximum rate.
B	Effective	IEGM among 60,0% e 74,9% of the maximum rate.
C+	In a process of adequacy	IEGM among 50,0% e 59,9% of the maximum rate.
C	Low level of adequacy	IEGM less than 50%.

Source: IRBCONTAS, 2015, p. 11.

[1] TCE-RJ – Available in: <http://www.tce.rj.gov.br/documents/43935520/0/Manual%20do%20IEGM%20-%20Ciclo%202017%20v1.1.pdf>. Access in: 26. set. 2018 – pages 18-84.

[2] Ministry of Science, Technology, Innovation and Communications - Secretariat for inclusion. List of Municipalities that have expressed an interest in participating in the "My Smart City" Project - Notice no. 214/2016 / SEI-MC. Available in: <http://digital goo.gl/mAU2Ni>. Access in: 26. out. 2018.

For the analysis of the ITG principles in the cities participating in the My Smart City project, the i-Gov-TI index was considered, which includes policies for the use of information technology, information security, staff training and transparency, totalizing ten indicators and 21 issues (IRBCONTAS, 2015, p. 10; TCE-RJ, 2017, p. 65).

Table 2. Indicators that make up i-GOV IT

Indicator	Count of questions	Maximum Score	Total
IT training	1	4	4
IT skills	1	5	5
Communication and training	1	6	6
Open Data	4	5	20
Open Data (no score)	2	0	0
Open Data (bidding)	2	3	6
Computerization of processes	3	8	24
Computerization of processes (no score)	1	0	0
Computerization of processes (bidding)	1	6	6
Metrics for software acquisition	1	0	0
Information Technology Master Plan (PDTI)	1	8	8
IT staff	1	8	8
Information Security Policy	1	5	5
Alignment IT / municipal bodies	1	8	8
Grand Total	21	66	100

Source: Adapted by the authors ofTCE-RJ (2017, p. 64-68).

Table 2 data highlight the composition of i-GOV IT index with a predominance of punctuation aimed at the processes computerization in municipal sectors and the availability of digital data for free access.IEGM Brazil is composed of a government data combination and other information official sources; data from automated systems to support supervision (TAAC - Computer Assisted Audit Techniques); and information gathered from questionnaires filled out by the Municipalities. The mathematical calculations are performed through algorithms and computational routines using the weights assigned to the indicators. Each index indicator has a weight in relation to its importance, reflecting public finances and in relation to management (TCE-RJ, 2017, p.35).Table 3 presents the calculation metrics for IEGM Brazil and i-GOV-TI.

Table 3. IEGM and i-GOV-IT calculation metrics

Weight: i-GOV TI: 05/100 - 0.05 (5%) Calculation: i-GOV TI = (Sum of indicators) / 100 IEGM = (i-EDUC x 20 + i-HEALTH x 20 + i-PLANNING x 20 + FISCAL x 20 + i-ENVIRONMENT x 10 + i-CITY x 5 + i-GOV TI x 5) / 100

Source: TCE-RJ, 2017, p. 69.

It should be noted that the IEGM Brazil score is "based on information provided by the municipalities themselves, which may have been validated by sampling by the audit teams of the Audit Courts, according to their possibilities" (IRBCONTAS, 2015, p.13). Manual and automated searches were carried out in the municipalities' websites under the terms "governance", "pdti", "information technology" and "technology and innovation", in order to identify official publications related to the ITG and / or related documents, besides observation of the existence of agencies, secretariats and / or sectors related to the ICT area. The results of the analyzes were compared with the IEGM Brazil data in search of convergences or divergences. The research carried out a compilation in search of the main indicators of smart cities established in the literature, in order

to verify if the cities of the project My City Smart with higher or lower indexes in i-Gov TI had a correlation with the other indexes established by IEGM Brazil.The correlation study makes it possible to determine (measure) the degree of relationship between two variables (Hair, Black, Babin, Anderson, & Tatham, 2009).

- Null Hypothesis (H0): $\rho = 0$ (there is no correlation between i-GOV TI and the index);
- Alternative hypothesis (H1): $\rho \neq 0$ (there is a significant correlation).

The Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) normality tests were used to define the most appropriate correlation method for the data under analysis (Torman, Coster, &Riboldi, 2012). The test indicated non-normality, and in this situation Spearman's nonparametric correlation test was recommended (Conover, 1999; Öztuna, Elhan, &Tüccar, 2006). The Spearman's Correlation Coefficient (ρ) measures the intensity of the relationship between ordinal variables, ranging from -1 (inverse relation) to +1 (direct relation) (Sharma, 1996; Manly, 2008). For the test, the following analysis parameters were used (Table 4):

Table 4. Parameters for Spearman coefficientanalysis

Results	Spearman Coefficient (ρ)
[0,90; 1]	Very strong
[0,70; 0,899]	Strong
[0,40; 0,699]	Moderate
[0,20; 0,399]	Weak
[0 a 0,199]	Very weak

Source: Adapted from Finney (1980).

From the definition of the methodological aspects, the following section presents the results and their respective analysis regarding the adequacy of the study object of this work.

DISCUSSIONS

According to the Brazilian public announcement of the State Ministry of Communications concerning the "My Smart City" project, cities classified as average will receive 50% of the total budget, however, most of the registered cities were classified as small (85.51% - Table 5).It was observed that the majority of the cities participating in the project are from: Minas Gerais - 53 (Brazilian Southeast State); Bahia - 50 (Brazilian Northeast State), and São Paulo – 42 (Brazilian Southeast State).Table 6 shows that the notice establishes preference for the north and northeast regions, due to the low index of digital inclusion (Przeybilovicz, Cunha, & Quandt, 2014).

Table 5. Classification x inscribed cities

Classification according to public notice	Total listed cities	%
BIG	6	1,70%
MEDIUM	45	12,78%
SMALL	301	85,51%
Total:	352	100%

Source: Research data (2017).

Table 6. Cities x State

UF	Total	UF	Total	UF	Total
Alagoas	1	Minas Gerais	53	Rio Grande do Norte	8
Amazonas	2	Mato Grosso do Sul	4	Roraima	4
Amapá	2	Pará	6	Rio Grande do Sul	17
Bahia	50	Paraíba	13	Santa Catarina	7
Ceará	19	Pernambuco	3	Sergipe	1
Espírito Santo	1	Piauí	41	São Paulo	42
Goiás	14	Paraná	25	Tocantins	4
Maranhão	23	Rio de Janeiro	12	Total:	352

Source*:* Research data (2017).

i-GOV IT can be seen in the states in Table 7, stressing the District-federal that obtained the highest score of Brazil (B +), since this is an analysis that only in the city of Brasilia. The states with the lowest indexes were: Roraima, Maranhão and Paraíba. Brazil as a whole is classified with the lowest concept of the scale (C), indicating a low level of application of policies of use of information technology, information security, qualification of personnel and transparency. Data from the i-GOV IT (IEGM) were related only to the cities participating in the project My Smart City (MCI), resulting in 282 cities of 352 registered (80.11%), since not all participating cities have index IEGM Brazil 2015.Table 8 highlights a value of 0.35% for index A, which is represented by the city of Santos-SP, considered large by the scale of the IEGM and average by the MCI. Northeast Brazil stands out for the greater number of cities participating in the project and also for the greater number of cities classified in the lowest index of i-GOV IT, data that corroborate the project's goal to prioritize this region.North Region of Brazil has only 10 cities in the project My Smart City (MSC), however, three cities have i-GOV TI classified as B + (Guaraí / TO, Palmas / TO, Porto Velho / RO) and three as B (Porto Nacional / TO, Ji-Paraná / RO, Macapá / AP).

Brazilian Southeast and South regions together comprise 12 cities having the B + classification (Itaú de Minas / MG, Caraguatatuba / SP, Espírito Santo do Pinhal / SP, Guará / SP, Jundiaí / SP, Laranjal Paulista / SP, Mococa / SP, Pederneiras. A total of 58.33% of the cities are in the state of São Paulo and none of them in the state of Rio de Janeiro. The country's Midwest region has only the city of Campinorte / GO classified as B +. The data point to a domain of the cities located in the Southeast of Brazil with the highest indexes of i-GOV IT, in addition to a dissonance between the capital cities, mainly in the North and Northeast and the other cities. Such observations may be associated with a higher concentration of intellectual capital and the acquisition capacity oftechnological resources of these municipalities.In order to verifythe classifications of the cities as to the existence of a PDTI and an institutionallydefined agency in the ICT area in the cities classified with the A or B + index, a search was made in the electronic websites of each city hall and in search tools (Table 9).Only four City Halls present published PDTI on their electronic website, as well as an institutionalized ICT agency, and 83.33% (20) of the cities classified as A or B + do not have the main tool for diagnosis, planning and management of resources and Information Technology processes (SISP, 2010).

Table 7. i-GOV TI x Region

Region	State*	i-GOV TI	Scale	Region	State*	i-GOV TI	Scale
Midwest	Distrito Federal (DF)	0,87	B+	North	Rondônia (RO)	0,55	C+
Midwest	Goiás (GO)	0,52	C+	North	Roraima (RR)	0,34	C
Midwest	Mato Grosso do Sul (MS)	0,48	C	North	Acre (AC)	0,37	C
Northeast	Alagoas (AL)	0,39	C	North	Tocantins (TO)	0,41	C
Northeast	Bahia (BA)	0,43	C	Southeast	Espírito Santo (ES)	0,55	C+
Northeast	Ceará (CE)	0,52	C+	Southeast	Minas Gerais (MG)	0,41	C
Northeast	Maranhão (MA)	0,34	C	Southeast	Rio de Janeiro (RJ)	0,45	C
Northeast	Pernambuco (PB)	0,34	C	Southeast	São Paulo (SP)	0,52	C+
Northeast	Piauí (PI)	0,37	C	South	Rio Grande do Sul (RS)	0,51	C+
Northeast	Rio Grande do Norte (RN)	0,41	C	South	Santa Catarina (SC)	0,53	C+
Northeast	Sergipe (SE)	0,4	C	Brazil Average		0,46087	C
North	Amazonas (AM)	0,5	C+				
North	Amapá (AP)	0,39	C				

Source: Adapted by the authors of IEGM (2015).
**Some States have been omitted due to lack of data.*

Table 8. Classification of the cities in the MCI x i-GOV IT project

	A		B+		B		C+		C		TOTAL	
REGION	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Midwest	0,00%		0,35%	1	2,13%	6	0,71%	2	1,77%	5	4,96%	14
Northeast	0,00%		2,48%	7	6,03%	17	8,51%	24	30,14%	85	47,16%	133
North	0,00%		1,06%	3	1,06%	3	0,71%	2	0,71%	2	3,55%	10
Southeast	0,35%	1	3,19%	9	10,64%	30	7,80%	22	12,77%	36	34,75%	98
South	0,00%		1,06%	3	2,84%	8	3,19%	9	2,48%	7	9,57%	27
Total	0,35%	1	8,16%	23	22,70%	64	20,92%	59	47,87%	135	100,00%	282

Source: Research data (2017).

Table 9. City Halls presenting i-GOV IT A or B + and published PDTI

Cities	IEGM Scale	MCI Scale	
	Big	Big	Medium
João Pessoa/Northeast	X		X
Porto Alegre/South	X	X	
Salvador/Northeast	X	X	
Santos/Southeast	X		X
General Total	4	2	2

Source: Research data (2017).

Table 10. Cities with ICTs agencies, but no PDTI

State	Cities	i-GOV TI	ICTs agencies
GO	Goiânia	B	Data Processing Company of the Municipality of Goiânia.
MA	São Luís	B+	Municipal Secretary of Information and Technology.
MG	Itaú de Minas	B+	Municipal Secretary of IT.
	Juiz de Fora	B	Undersecretary of Information Technology.
	São Sebastião do Paraíso	C+	Department of Science and Technology.
	Sete Lagoas	B	Municipal Secretary of Planning, Budget and Technology.
	Varginha	B	Department of Technology linked to the Administration Department.
SC	São Lourenço do Oeste	B+	IT Direction, as well as a digital city project.
SP	Caraguatatuba	B+	Secretary of Planning and IT
	Itatiba	B	Department of Technology linked to the Finance area.
	Jaboticabal	B	Department of TI.
	Jundiaí	B+	IT director linked to the Department of Economic, Science and Technology Development
	Paulínia	B	Department of technology, but there is not much information about the agency.
	Suzano	B	Director of Information Technology.
	Tatuí	B	Department of TI.

Source: Research data (2017).

Among cities that did not have the A or B + in i-GOV IT index, although they had a PDTI, only two were identified, Macapá/AP and Natal/RN. It can be inferred that the city halls and industrialized cities, such as Santos/SP, have followed the recommendations of the Federal and State Audit Courts in defining a PDTI. Most of the Brazilian cities direct their purchasing processes and ICT projects without any type of planning and/or documentation that aligns these actions to a macro plan, such as a Strategic Master Plan (SMP) or similar, so that there would be an appropriate direction in the use and development of ICTs.The following Table 10 shows the cities that have ICTs institutionalized agencies, but they do not of a PDTI.Data from Table 10 highlight a predominance of cities in the states of Minas Gerais and São Paulo, with institutionalized ICT institutions. Goiás and Maranhão are represented by cities that are capitals in their respective states. It was observed that only six (2.12%) City Halls had a PDTI and 15 (5.31%) cities demonstrated to have an institutionalized IT body, but they did not have a document aligning between the objectives of the agency and the development of ICTs. It is observed in Table 8

that municipalities with institutionalized ICT institutions tend to have higher rates in i-GOV IT.Next, in Table 11, the Brazil IEGM indexes were analyzed for correlation, in order to verify if the i-GOV TI correlates with some other defined index and what would be its level.

the hypothesis H0 for all indices (Null Hypothesis). This type of result leads to differentinferences: initially, the i-GOV IT index does not analyze the impact of ICTs in other sectors. This fact is confirmed in the description of the index in the Brazil IEGM (2015).

Table 11. Spearman correlation for cities participating in theMSC project

		i-CITY	i-ENVIRONMENTAL	i-PLANNING	i-CONTROLLER	i-HEALTH	i-EDUCATION
i-GOV IT	Spearman correlation	,380**	,406**	,032	,046	,144*	,232**
	ρ	,000	,000	,589	,437	,016	,000
	N	282	282	282	282	282	282

*. Correlation is significant at 0.05 level.
**. Correlation is significant at 0.01 level.
Source: Research data (2017).

Table 12. Interpretation of the correlations of i-GOV TI

Index	Correlation result	Correlation interpretation
i-CITY	0,396 (H1 Accepted)	Positive weak correlation.
i-ENVIRONMENTAL	0,406 (H1 Accepted)	Positive moderate correlation.
i-PLANNING	- (H1 Rejected)	H0 was considered due to the significance level of 0.719.
i-CONTROLLER	- (H1 Rejected)	H0 was considered due to the significance level of 0.471.
i-HEATH	0,144 (H1 Accepted)	Very weak positive correlation.
i-EDUCATION	0,249 (H1 Accepted)	Positive weak correlation.

Source: Research data (2017).

Table 13. Spearman correlation for cities classified with i-GOV IT A or B+

		i-City	i-Environmental	i-Planning	i-Controller	i-Health	i-Education
i-GOV TI	Spearman Correlation	,235	,345	,216	,063	,150	,371
	ρ	,268	,099	,310	,769	,484	,075
	N	24	24	24	24	24	24

*. Correlation is significant at the 0.05 level.
**. Correlation is significant at the 0,01 level.
Source: Research data (2017).

Table 14. Spearman correlation for cities classified with i-GOV TI C or C+

		i-CITY	i-ENVIRONMENTAL	i-PLANNING	i-CONTROLLER	i-HEALTH	i-EDUCATION
i- Gov IT	Spearman correlations	,235**	,337**	,119	-,005	-,006	,067
	ρ	,001	,000	,099	,942	,930	,350
	N	194	194	194	194	194	194

*. Correlation is significant at 0.05 level.
**. Correlation is significant at the 0,01 level.
Source: Research data (2017).

A moderate Spearman correlation (> 0.40) was observed for the i-ENVIRONMENTAL index, which measures actions related to solid waste, basic sanitation, environmental education, environmental structure and environmental council, demonstrating a certain relationship with ITG activities. For the i-CITY, which measures the municipal planning on contingency plans, identification of risks for intervention of the Public Power and Civil Defense infrastructure, the correlation can be considered weak (<0,400). The i-EDUC, which includes information on school evaluation, vacancy planning, the Municipal Council of Education, infrastructure problems, school meals, teachers' status and qualifications, quantity of vacancies, school material and uniform, also presented a weak correlation, as well as i-SAUDE, which got a very weak correlation (<0.20).Briefly and considering the Null hypotheses (H0): $\rho = 0$ (there is no correlation between i-GOV TI and the index); and Alternative (H1): $\rho \neq 0$ (there is a significant correlation), Table 12 is presented.Considering the results, this research verified if the correlations would be different for cities that have an i-GOV IT classified in A or B +. The results are shown in Table 13.The results of the correlation analysis of Table 13, indicate absence of correlation among i-GOV TI and all other indices, accepting

The "i-GOV IT gathers information on information technology policies, information security, staff training and transparency ". Another inference may be related to the overvaluation of the index by the respondents, which would justify the lack of correlation for the other indices. On the other hand, the results can also indicate a real independence of the level of ITG of the city halls in relation to the other indexes, justifying more detailed researches and/or the redefinition of i-GOV IT index indicators;currently the index is composed of 10 indicators, the highest scores being represented by the processes computerization (24%) and the availability of data for free access (20%) (TCE-RJ, 2017).A certain divergence regarding the literature definition is perceived, the ITG should be more concerned with decision-making and planning aspects than with technical resources (De Haes&Grembergen, 2017).The next test sought to verify the existence of correlation of the cities that had the i-GOV IT classified with the lowest grades, C or C +.Results from Table 14 show a very weak correlation for the i-CITY and i-ENVIRONMENTAL indices, and for all other indices the results were not considered due to the low percentage of significance. It can be inferred that Brazilian cities with low ITG index tend to have lower indexes in i-CITY, in addition to a low index in i-ENVIRONMENTAL.It

should be noted that Spearman's correlation analysis does not indicate a cause / effect relationship, but it only observes if the variables are associated and their degree of association. In order to make possible inferences directed to the impact of ICT in the sectors of a city hall, the i-GOV IT should be more comprehensive, following the principles of the COBIT 5 framework, in "enabling a holistic view; and cover the organization from end to end "(ISACA, 2012, p.25-26). The data refer to the evaluation of the "My Smart City" project announcement, which intends to implement several technological resources in cities considered medium-sized (50% of the budget / ~ 909,000 US dollars / city) and small (30% of the budget / ~ 303 a thousand dollars / city), remaining 20% of the budget for the large cities (~ 2.5 million dollars / city) that are presented in the research as the only ones to be able to meet the criteria of the announcement. The total investment for the development of the project "My Smart City" to all registered cities totals approximately 144 million dollars. It is believed that there is a divergence in the reality of Brazilian cities and of the public policies directed at cities in relation to ICTs, and that there are huge investments in infrastructure without the basic principles of governance and management. According to the fifth principle of COBIT 5 (ISACA, 2012, p.33), "governance ensures that stakeholder needs, conditions and options are assessed in order to determine agreed and balanced corporate goals," while " management is responsible for planning, developing, executing and monitoring activities in accordance with the direction defined by the governing body in order to achieve corporate objectives. " The PDTI represents the formalization of the IT governance guidelines that must be monitored and executed by the management bodies.With regard to compliance with standards that aim to establish the ITG in federal, state and municipal bodies, only six (2.12%) City Halll administrations met the recommendation to develop a PDTI and 15 (5.31%) cities demonstrated to have an organ institutionalized IT but did not have a PDTI.

Weill and Ross (2004) and Fernandes and Abreu (2014) consider that a planning document that aligns the organization's strategies to the ICT area is fundamental for the development of the ITG and is considered the initial step towards the establishment of a ITG plan.Weill and Ross (2004), when defining the matrix of decisions in ICTs, considered several archetypes related to the decision-making process in ICT, and established the premise that the organizations with greater performance in IT use different archetypes of decision making, referring the necessity of an institutionalized and participatory IT body in decision-making processes. Therefore, actions are properly directed, and the best decision made for the organization, avoiding investments that are not linked to the company's strategies and that do not add value. In this perspective, the i-GOVIT composition which is much more associated to aspects of management than to IT governance.Regarding the concept of smart cities, there is in the literature some agreement to define ICT as the basis for the development of a smart city (Jucevicius *et al*, 2014; Navarro *et al*, 2017; Ahvenniemi *et al*, 2017). However, there are divergences in the indicators that should compose its structure. The study sought to identify those indicators that were most related to the IT area, in the main index of development of the Brazilian cities (IEGM Brazil), considering that these should be the initial areas for alignment to the ICTs seeking the development of a smart city. In this sense, the environmental (i-ENVIRONMENTAL) and infrastructure (i-CITY) indicators are justified, because of the correlations presented and because they have administrative processes that demand the use of ICT in information control and resource monitoring.Due to the conceptual scope of the theme of smart cities, the evolution of a city to become "smart" should be carried out, initially, by areas related to ICTs, involving planning and alignment with management strategies, as well as it is advocated in the organizational environment. ICT as an artifact endowed with social, technological and informational elements requires an integrated view of the dimensions of an intelligent city.It is also considered that smart governance (Meijer & Bolívar, 2016; Viale Pereira *et al*., 2017) delimits the actions in ITG to support the collaborative activities between municipal agencies and citizens.

Conclusions

The project "My Smart City" from the Brazilian federal government can be considered a valid initiative to a complex issue. However, it has presented divergent from practices and even the goal itself. The concept of smart city is much more comprehensive than the implementation of telecommunication resources in the cities. This project expresses a greater concern with the concept of digital cities, being far from the principles of smart cities. For Caragliu*et al*. (2011, p. 67) "the availability and quality of an ICT infrastructure does not represent intelligence or defined a city as been smart".It is appropriate at this time to resume the research question about the analysis of the application of principles of ITG in Brazilian cities participating in the project "My Smart City" from the federal government. It can be inferred that the cities participating in the project have a level considered non-existent of ITG principles, except for state capitals and large centers. Public policies for the implementation and development of ITG, already instituted by federal and state inspection bodies, are neglected by the vast majority of municipalities, which makes it difficult to invest in institutions that do not have the minimum control over their information, processes and public data security.The state is acting in the opposite direction to the process of control, organization and direction of public spending since it consolidates projects with high costs to be implemented in environments with very low level of governance and management. An inverse approach focused on the preparation of ICT governance and management plans and aimed at training managers to integrate the indicators that make up a smart city would be considered a more sensible way to apply public policies and budgets. Smart city governance must be concerned with the interaction between the social structures, governmental and new technologies that will make up the smart city project.

In sequence, the ITG mechanisms are defined to support the social, technological and informational aspects of the IS artifact.The study presented guiding results for the adjustment of Brazilian cities to the concept of smart city. It should be emphasized that the environmental and infrastructure areas can present a higher level of development when ITG principles also develop, as well as the planning of actions through a PDTI and the institutionalization of ICT institutions can contribute to the municipalities preparing for innovation and development projects based on ICTs. The discussions contribute to the reflection of projects of smart cities in developing countries, such as those of Latin America and the Caribbean. The Brazilian project presents a technical approach without considering the social aspirations and the diversity of a

continentally comprehensible country.This study requires a deeper understanding of the real impact that ITG can have on the different indicators of a smart city; studies in other cities in the Latin America, Europe, Africa or Asia can establish a baseline for comparisons and the development of new research.The main limitation of the research work in the city halls in relation to the use and application of ICTs is the main limitation of the work, due to the marked absence of data available electronically and / or disclosed.

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