REGE
Revista de Gestão

Number 1

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Revista de Gestão (REGE) published by the Business Administration Department of the School of Economics, Business and Accounting - Universidade de São Paulo, Brazil, is an academic-scientific quarterly publication dedicated to the dissemination of research and ideas that add value to the work of scholars and practitioners in the field of Management. The journal aims to publish papers of diverse subjects and geographical origins, trying to show a comprehensive picture of the relevant scientific production in the field of management, both nationally and internationally. Articles accepted for publication are selected on the basis of originality, quality and creativity.

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ISSN 2177-8736
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Emerald is a trading name of Emerald Publishing Limited
Printed by CPI Group (UK) Ltd, Croydon, CR0 4YY

ISOQAR certified Management System, awarded to Emerald for adherence to Environmental standards
ISO 14001:2004

Certificate Number: 1655

Quarter trim size: 174mm x 240mm
Editorial

Journal indexing – a critical reflection

Indexing was originally a way to make the research work more efficient through the access to select and reliable scientific information sources (journals) and to the research disseminated by these sources. However, indexing (especially in terms of international databases, such as Scopus, SciELO and Web of Science) became currently a seal of quality of scientific journals as well as the research published in them.

Therefore, indexing became a complex and sometimes polemic matter and became the target of several academic studies and also editors of journals and researchers. This is a recurrent theme when we address the issue of evaluating research institutions and individual researchers, because the journal in which a paper is published, the bases in which this journal are indexed and its impact on the academic community are, among others, indicators used to evaluate the quality and the productivity of institutions and researchers.

To be indexed in one of these bases is a relevant fact for a journal to get more visibility in terms of published research, while attracting prestigious scholars and measuring its impact on the area of research. According to authors, publishing in an indexed journal entails the possibility to get more readers and quotes of their papers, which increases the author’s reputation in the field.

Nowadays, it is common to use quote and impact indicators produced by these indexers in order to evaluate researchers and institutions. These indicators are also present in the most important international university rankings. For this reason, several journals want to be a part of these databases, and researchers seek to publish their papers in journals that are indexed in the same databases.

However, as researchers in the area of administration, we must question: does the selection process of these indexers is in fact evaluating the quality of the journal as well as the published papers?

It is important, therefore, to discuss which would be the main criteria for a journal to become part of these indexers. The criteria used for indexing in the main databases, such as SciELO, Scopus and Web of Science, can be divided into four groups: regularity and punctuality; basic criteria for admission; editorial content; and reputation of the journal.

Regularity and punctuality of the journal is the first requirement to be evaluated by indexers, which is essential for the continuity of evaluations. Indexers verify in this criterion the capacity of the journal to publish in the established frequency (bimonthly, quarterly, etc.), with minimum delay and stable pattern of papers per edition.

The basic criteria for admission are the ones that, when not met by the journal, can interrupt the evaluation process only to be resumed later (after the journal meet these criteria). The main basic criteria for admission of both indexers are:

(1) two years of existence (minimum recommended);

(2) ISSN registration;
(3) the content of the journal must be peer-reviewed and make publicly available the description of the reviewing process, the sort of peer-evaluation accomplished (open, single-blind, double-blind) and the steps of the process;

(4) the publication of the complete text in English is recommended (or metadata at least – title and abstract);

(5) international editorial convention:
   • the title of the journal has to be informative; abstract and title of the papers must be descriptive; complete bibliographic information in the references; authors’ address and affiliation; and

(6) to have a “code of ethics” and good practice in publication available on the website.

The code of ethics of the journal is one of the most important issues among the basic criteria and has to present information on important ethical issues (such as originality, plagiarism, collaboration/authorship, fraud, conflict of interest, corrections, disclaimer, among others) and the actions to be taken by the journal in case of ethical violation.

Regarding the editorial content, the indexers must evaluate the editorial policy of the journal, i.e., if the journal has a scope and a convincing editorial concept and if it is relevant for database users. One important issue to be evaluated is if the focus/scope of the journal is different from the ones of other indexed journals in the area and what is the differential of the journal; in other words, how the journal will add new information to the already established indexed group of journals. If the content approached by the journal is already been covered by other periodicals, it is likely that indexers will not accept the inclusion of this journal.

Another important issue related to the editorial content is the geographic diversity of authors, editors, and members of the editorial board of the journal. It is important to not only have geographic diversity, but that this diversity is aligned with the focus/scope and target audience of the journal. An international journal must:
   • present a content that is interesting for the international scientific community (in alignment with the announced objectives and scope);
   • present a diversity of authors, editors and members of the editorial board with representation from different regions and countries; and
   • highly desirable publication in English.

It is important to remember that the focus of these indexers is on international journals. To put the word “international” in the title is not enough for a journal to fit in this category, i.e., it is necessary to have an alignment between editorial policy and actors (authors, editors, etc.), while being in accordance with the content of international journals. Local/regional journals (whose objective and scope are limited to the interest of a limited region or country; they publish mostly in a language other than English; present editors, authors and members of the editorial board in the country/region where the journal is published) are also accepted (more by Scopus and less by Web of Science), but these journals have to be excellent and must add new information to the content of indexers about a determined subject or to provide a specific regional perspective.

The last group of criteria is related to the reputation of the journal. In this requirement, the quotes of the journal are evaluated in order to determine the importance and influence of this journal in the literature that involves the theme. Based on the quotes, indexers will calculate the impact index (impact factor, CiteScore, H-Index, etc.) in order to verify the position expected from the journal
in relation to the other journals in the same area of knowledge. The record quote of authors, editors and members of the editorial board will also be analysed in order to determine if the journal is capable of attracting established researchers in the determined area of knowledge.

Considering these four groups of criteria, especially the last two ones, it is possible to notice that journals edited in Brazil can have difficulties to fit in these criteria. For instance, many journals have a regional or local focus, present high quality and could be indexed, but would have difficulties in meeting all the required criteria to be indexed.

A potential problem of this evaluation process is that discussion is no longer about the quality of the research and the relevance of the target audience; it is about fitting into the criteria established by indexers. It is important to be indexed, but such indexation does not ensure the quality of the published papers and their contribution for science.

Adriana Marotti de Mello
Universidade de Sao Paulo, Sao Paulo, Brazil, and

Luisa de Sandes-Guimarães
Universidade de Sao Paulo, Sao Paulo, Brazil
Impacts of the spirit of initiative and identification with the organization on IT governance effectiveness perception in public organizations

Guilherme Costa Wiedenhöft
Escola Politécnica, Pontificia Universidade Catolica do Rio Grande do Sul, Porto Alegre, Brazil

Edimara Mezzomo Luciano
Programa de Pós-Graduação em Administração, Pontificia Universidade Catolica do Rio Grande do Sul, Porto Alegre, Brazil, and
Josiane Brietzke Porto
Escola Politécnica, Universidade do Vale do Rio dos Sinos, Sao Leopoldo, Brazil

Abstract
Purpose – The purpose of this paper is to address the process of organizational governance of IT resources, called IT governance (ITG), especially its behavioral approach. The organizational citizenship behavior (OCB) concept was used to understand the relationship between the behavioral dimensions and the perception of ITG effectiveness. The objective of this research is to identify if individuals’ behavior contributes to a greater perception of ITG effectiveness in public organizations. This is an exploratory and descriptive research with a quantitative approach.

Design/methodology/approach – This was an exploratory and descriptive research with a quantitative approach. A survey with IT teams of public organizations in a Brazilian state was performed, and data were analyzed through partial least squares. A positive and significant relationship between the variables Spirit of Initiative ($R^2 = 0.2926$) and Identification with the Organization ($R^2 = 0.1276$), and the perception of ITG effectiveness was found.

Findings – Results showed that when OCB levels are higher, ITG is more easily perceived as effective. This occurs because the predisposition to adopt ITG mechanisms increases the changes in the governance process, which are understood as significant by the organization. In addition, it is important to consider the impact of change on individuals, due to ITG adoption. This reinforces that ITG is not just about the IT department, but also refers to its adoption and use throughout the organization as a key resource for the implementation of public policies and for following governmental strategies.

Research limitations/implications – The predictive capacity of the proposed relationship model requires a larger number of confirmatory studies. Its application is suggested in other federative units or in private organizations.

Practical implications – OCB increases the predisposition to adopt ITG mechanisms, provided they understand that changes in the governance process are important to the organization. The change impact on individuals due to ITG adoption is also relevant, which shows that ITG is not only about the IT department, but also about IT adoption and its use throughout the organization.
Originality/value – The paper helps understanding the behavioral effects on the effectiveness of the GTI, since the simple adoption of GTI mechanisms does not guarantee that they are effective in achieving its objective of responding to governmental demands.

Keywords Organizational citizenship behaviour (OCB), Organizational behaviour, IT governance, Effectiveness, Public organizations, Partial least squares

Paper type Research paper

1. Introduction

Connections between government and citizens are changing (Cunha and Miranda, 2013), and this process creates new demands for fast and reliable data, information and services whose implementation depends on, involves or is enabled by IT solutions (Luciano et al., 2016). These initiatives are implemented through a complex network of public and private actors (who work in commissioned public services), which aim to improve public services to citizens, increase effectiveness and extend transparency in public management. Considering that these goals are very distinct and complex, although complementary, it is important to establish a governance structure to orchestrate all actors and efforts, which contributes to reduce risks in service delivery. Decision making on ICT outside a governance process can more easily increase ad hoc solutions (Nfuka and Rusu, 2011), which, in turn, unnecessarily raise complexity and transaction costs, undermining future investments and hampering the planning of new initiatives, as well as the management of current ones. Gradually, key IT issues are no longer about the organization’s software and hardware but have moved to the strategic level, dealing with definitions and policies on how technology and its resources should be used to create a competitive advantage for organizations (Bartenschlager and Goeken, 2010), or public value, in the case of public organizations. This shows that IT governance (ITG) does not address the IT department, but it is about IT adoption and its use throughout the organization.

Governance in public organizations involves processes and structures for decision making on public policies and their management, to engage people from different government levels and other public and private agents in order to achieve a public purpose that, otherwise, could not be attained (Peters, 1998). It also concerns the decision on how much coordination and control are appropriate in each situation and context (Grandori, 1997). When applied to IT decisions, governance can be understood as a set of authority arrangements and standards for IT strategic activities (Sambamurthy and Zmud, 1999), composed of a group of structure, process and relationship mechanisms that implement high-level definitions. A governance process applied to IT regards the decision-making framework and the establishment of rights and responsibilities to encourage desirable behaviors related to IT (Weill and Ross, 2004).

ITG studies suggest the existence of two main paths of action for adopting its mechanisms (Sambamurthy and Zmud, 1999; Peterson, 2004; Van Grembergen et al., 2004; Weill and Ross, 2004; Huang et al., 2010). One of the pillars focuses on legal and regulatory aspects and the other one focuses on the behavioral factor inherent to individuals that deal with IT, in its different expressions – IT artifacts (equipment, tools and applications), information and usage policies. ITG mechanisms should be able to encourage the desired behavior of individuals regarding IT aspects (Weill and Ross, 2004). The incentive for the desirable behavior complements the normative side of governance, contributing to a consistent and aligned relationship between business and IT. This behavioral expression of ITG is the focus of this research.

In public organizations, the adoption of normative and control mechanisms is not sufficient to achieve ITG effectiveness, since they cannot handle all situations related to the use of IT resources in such organizations; thus, each individual should interpret the situation and position himself/herself in order to contribute the most to attain the organization’s goals. Therefore, non-prescribed behaviors (in laws, decrees, ordinances and policies) are necessary
to solve the individual’s predicament in the organization, created by non-standard and non-regulated situations. A non-regulated situation that can paralyze the activities demands an extra-role behavior.

Organizational citizenship behavior (OCB) describes the voluntary commitment of a person to an organization, with attitudes that are not part of his/her contractual functions (Rego et al., 2010). It consists of protection actions taken by the employees, which aim to safeguard an organization and everything that belongs to it, contributing to a favorable environment. For example, even if the norm for a particular acquisition is a monocratic and individual decision, a civil servant with a high OCB can suggest that a collegiate decision would be more appropriate for the situation, due to its potential implications, thus protecting the institution from future issues.

The objective of this study was to identify the dimensions of OCB that contribute to increase the effectiveness of ITG through the perception of IT individuals who work in public organizations. It is important to understand the behavioral effects on ITG perceived effectiveness, since the simple adoption of ITG mechanisms does not ensure that they will be effective in meeting governmental demands. This situation happens because the adoption of such mechanisms can be done through phenomena such as mimetic, normative and coercive isomorphism, hindering the alignment with public organizations’ objectives or being considered illegitimate by their employees.

In addition to this Introduction, the paper has four more sections. The theoretical framework that supports the research is presented in Section 2. Section 3 presents the methodological procedures adopted, followed by the results and main findings (Section 4). Section 5 discusses the final remarks and suggestions for future research.

2. Theoretical framework
This section addresses the conceptual aspects that are part of this study, such as ITG and OCB.

2.1 Governance of IT resources in public organizations
Public management reform has three ways to ensure transparency: social control; control through management contracts and results; and controlled competition. The principles that guided public management reform were oriented to results, efficiency, governance and market practices (Diniz et al., 2009). Accordingly, the complexity of government’s modern problems requires more efficient managers, and also the need to consider the relevance of organizations’ behavioral and cultural aspects, which are key factors for solving these problems (Bresser-Pereira, 2002).

IT use enabled the change in the public management model, with the emergence of electronic government (e-Gov) and citizen-oriented services (Diniz et al., 2009). IT can be a solution for governments, with regard to the growing demand for transparency and accountability (Joia, 2009). The internet arrival has brought greater visibility to public organizations by disseminating their e-Gov applications worldwide, which led to the increase in the number of organizations that use ICTs (Heeks, 2005).

In Brazil, several authors have focused on the topic of IT use in public organizations, such as Cunha et al. (2009), Diniz et al. (2009), Medeiros and Guimarães (2006), Joia (2009) and Laia et al. (2011). They mainly address e-government and IT use in public services, IT use for governance and democracy, and the strategic use of technology in governments, which involves government services and sociocultural impacts of ICT.

Barrett (2001) highlights the differences between public and private organizations, regarding ITG. In the former, there is a greater influence of the political environment and value systems, which emphasize compliance with legal provisions. ITG models in the public and private sectors are similar in their basic pillars (principles, objectives and mechanisms),
but the sectors are very different in terms of environmental aspects that involve external and internal institutional pressures. Moreover, institutional pressures are an important source of demands for IT areas in public organizations, and the financial and market pressures, inherent to the private sector, are driving forces of demand in companies (Rodrigues and Souza, 2012). For the authors, the biggest divergence between public and private sectors is how agents responsible for governance react to these pressures.

ITG in public organizations can be understood as the financial and administrative capacity to implement public policies that aim to make the State stronger, by overcoming the fiscal crisis, delimiting its area of activity, distinguishing between the strategic core and decentralized units, establishing a political elite able to make the necessary decisions and allocating a motivated and skilled bureaucracy (Cunha, 2000). Diniz et al. (2009) provide a broad view of electronic governance that considers the internal elements of public administration, such as processes, relationships and structures, and external aspects such as public services, participation and control.

According to Rocheleau and Wu (2002), the main difference between ITG in the public and private sectors lies in the fact that the public sector provides public goods and services, rather than services or products for sale. However, ITG in the public sector does not show significant conceptual differences from ITG in the private sector. Therefore, the IT complex environment and IGT weaknesses in the Brazilian public sector are mainly caused by the absence of a good public governance, due to institutional and behavioral aspects.

ITG can be understood through the synergy of mechanisms arranged in three main pillars: structure, processes and relationships. Structural arrangements are formed by business units and their roles and responsibilities, for the correct decision making on IT (Weill and Ross, 2004). Process arrangements and practices are directed toward the implementation of management and definition of procedures according to the strategies and policies defined for IT. The relationship ensures that defined arrangements and ITG processes are conducted to guarantee the effectiveness of use of IT assets, enabling them to seize opportunities and add higher value to the business (Bowen et al., 2007).

In recent years, different authors tried to identify the main ITG mechanisms, such as Sambamurthy and Zmud (1999) and Peterson (2004), who distinguished the process, relationship and structure mechanisms. Van Grembergen et al. (2004) studied the mechanisms in the European context based on market frameworks, while Weill and Ross (2004) and Huang et al. (2010) addressed the deliberative committees and the importance of roles and responsibilities. In Brazil, Lunardi et al. (2010) and Wiedenhoft and Klein (2013) gave attention to specific mechanisms for local companies. However, Peterson (2004) was one of the first scholars to define a set of mechanisms for ITG, arguing that they act in order to meet the organization’s goals regarding IT, by respecting the principles of corporate or organizational governance. As a result, these mechanisms must be associated with one or more ITG objectives (Van Grembergen et al., 2004).

In the perception of Weill and Ross (2004), the structure, processes and relationship mechanisms are the main way to express IGT needs. These mechanisms take into account the organizational arrangements for IT decision making, the processes that make IT work and the relationships to address and manage the different activities involved.

The relevance of the studies on ITG mechanisms is evident in the international academic scene, as several researchers have addressed these arrangements and practices, in recent years. Bowen et al. (2007) conducted a case study in a large organization, exploring the elements that affect ITG mechanisms, and showed that ITG performance is associated with mechanisms such as the shared understanding of business and IT objectives, the active involvement of IT committees in direction and decisions, and strategies and policies shared and communicated between business and IT. Weill and Ross (2004), through a survey of 250 companies from different countries, demonstrated
that the adoption of ITG mechanisms can be a profitable investment, especially those of decision making and relationship.

Ali and Green (2007) suggest a positive and significant correlation between the general level of ITG effectiveness and the relationship mechanisms, mainly those involving top management in IT, ethics or culture of compliance with policies, guidelines and procedures, and the set of formal/informal communication practices. Prasad et al. (2010) suggest that organizations that have ITG framework mechanisms, such as IT strategy committees and IT steering committee, show high levels of performance and a greater capacity of IT resources. Wu et al. (2015) examined the relationship between ITG and the mechanisms of IT strategic planning/information systems, performance measurement systems and methods for assessing the levels of IT strategic alignment and organizational performance. Results show that strategic alignment is an important factor for enhancing ITG effect on company's effectiveness.

Regardless of the strategic positioning of organizations, the adoption of ITG mechanisms has become an essential discussion in the agenda. In this sense, organizations try to increase assertiveness in relation to the adoption of ITG mechanisms, so that they help to achieve top management’s expected goals (Weill and Ross, 2004). The decision or choice of which ITG mechanisms to adopt in organizations should be based on the effectiveness model implemented by them, in line with what they showed. However, decisions in organizations are often made on the basis of subjective stimuli, in an unconscious quest for legitimation.

2.2 Organizational citizenship behavior (OCB)
Organizations face a dilemma. While it is essential that employees carry out what they have been assigned for by contract, they require that individuals choose behaviors that go beyond the demands of their role (Cunha et al., 2006). The importance of this type of behavior for organizations stems from their need of flexibility to deal with many unexpected situations that arise in the organizational daily routine (Smith et al., 1983). Based on these authors and a series of previous studies, the term OCB was academically established.

OCB dimensions include behaviors related to the individual’s attitudes toward the organization, expressed through the dimensions conscientiousness, sportsmanship and civic virtue, which refer to situations in which an individual complies with the rules and regulations even when no one sees it, or when he/she adopts an attitude that benefits the organization’s image (Rego, 1999). In its dimensions of altruism and courtesy, OCB expresses the individual behaviors in relation to other members of the organization, showing an individual and/or organizational focus. It is important to acknowledge that cultural contexts may interfere with conceptions of what can or cannot be understood as OCB (Rego, 2002). Some OCB dimensions may be specific to the country/culture where studies are carried out, and cannot be considered universal for all contexts.

Cultural contexts are elements that contribute to the contingency view of OCB dimensions (Païne and Organ, 2000; Paillé et al., 2010). Rego (1999), based on the assumption that OCB has a contingency attribute, validated an instrument adapted to the Portuguese reality, in which four OCB dimensions emerged, as shown in Table I.

Different modus operandi affect the need for extra-role behaviors. In countries with clearer and more stable rules and regulations, it is less necessary to adopt an extra-role behavior, since the chances of having clear laws, rules, policies, manuals and processes are bigger than in countries with cultures that do not appreciate law enforcement. It is important to understand that OCB is not an inappropriate or improper behavior, but rather a necessary one for developing activities. As an example, in a situation where rules, processes or policies refer to each other, creating a loop, the employee must adopt an extra-role behavior and decide how to solve the issue, so that the process goes forward and
the organization provides its services. Of course, there are extra-role behaviors that may have other intentions, not linked to the organization’s preservation, but these are not the OCB focus.

3. Research method
This is an exploratory and cross-sectional descriptive research, with a quantitative focus, given the techniques used for data collection and analysis. A survey was conducted considering it was the appropriate approach for the research purpose and strategy. Figure 1 presents the main stages of the research protocol.

After identifying the concepts and approaches related to the research topic, we created and validated a research instrument by using the statistical tests described in the following sections. After validation, we collected and analyzed data statistically, in order to attain the research objective.

3.1 Development and validation of the research instrument
In order to study the relationships between the variables OCB and ITG perceived effectiveness, we developed the structural model, shown in Figure 2, which served as a basis for building the data collection instrument (questionnaire).

The model presents the variables and relationships analyzed in our study, which show the influence of OCB dimensions on the perception of ITG effectiveness. We divided the instrument in three parts, with six questions, in a six-point Likert type scale, to evaluate ITG Perceived Effectiveness (based on Luciano et al., 2016); 15 questions, in a six-point agreement scale of the Likert type, to assess OCB

### Table I. OCB dimensions

<table>
<thead>
<tr>
<th>OCB dimension</th>
<th>Description</th>
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<tbody>
<tr>
<td>Interpersonal Harmony (IH)</td>
<td>Dimension related to interpersonal harmony, participation, team spirit, companionship and share of knowledge and experience</td>
</tr>
<tr>
<td>Conscientiousness (CO)</td>
<td>Dimension that reflects behaviors of obedience, conscientiousness and protection of the organization’s resources</td>
</tr>
<tr>
<td>Spirit of Initiative (SI)</td>
<td>Dimension that reveals spirit of initiative, availability to solve problems and find alternative solutions, spontaneity in making constructive suggestions for improvement</td>
</tr>
<tr>
<td>Identification with the Organization (IO)</td>
<td>Dimension that shows that the individual makes extra efforts and tries to defend the organization’s image with attitudes that praise its positive aspects in front of people outside the organization</td>
</tr>
</tbody>
</table>

Source: Adapted from Rego (1999)
We defined the respondents’ profile as civil servants working directly in the IT area or in related areas, representing the business in IT matters, with a minimum of two years of working at the institution – we assumed that these employees would be more familiar with ITG mechanisms. We submitted the first version of the instrument to four researchers who study ITG or have a focus on public administration, in order to receive suggestions to better adapt it to the objectives and to the respondents’ profile. We carried out the instrument’s face validation through a group discussion with 11 civil servants that are members of one of the ITG committees in the state of Rio Grande do Sul (RS). Thereafter, the suggestions considered relevant led to some changes, mainly by adjusting the instrument’s language to the respondents.

Finally, we conducted a survey with IT civil servants of Thereafter RS Government, in order to collect the necessary data for the instrument’s pre-test. Due to the complexity of their profile and the difficulty to access them, we chose to collect data and perform post hoc tests by using the free software G*Power 3.1.9 (Faul et al., 2009). The sample’s power test, for the 74 valid cases, resulted in a Power (1−β err prob) value equal to 0.7336, with the effect size ($f^2$) of 0.15. Hair et al. (2014) recommend Power values close to 0.80, with effect size ($f^2$) of 0.15. There was a small difference between the recommended and achieved values; however, we understood that the sample was appropriate because these were pre-test data that could be corrected during the final data collection.

In order to ensure data suitability, due to the complexity of respondents’ profile, we analyzed the correlation matrix, where the value of 0.781 of the Kaiser–Meyer–Olkin test, as well as Bartlett’s sphericity test ($\chi^2 = 1,797.802; \text{df} = 465$ and $p = 0.000$) showed that the data were appropriate for factor analysis. Thus, we proceeded with the analysis of the main components, through which we could demonstrate that the five factors correspond to 71.54 percent of the total variance explained. Finally, to test the reliability of the research instrument, we carried out Cronbach’s $\alpha$ test (0.862), based on standardized items (0.850), for the 21 items of the questionnaire, which demonstrated the applicability of the instrument for the final data collection.

### 3.2 Data collection
We carried out the final data collection during the second semester of 2016, in government bodies and sectors of the Direct Administration of the state of Rio Grande do Sul, which has around 1,200 employees working in IT areas. A total of 500 printed questionnaires...
were distributed and collected in person. The answers were then tabulated using Qualtrics® software. As suggested by Hair et al. (2014), data purification was done by removing the cases that had incomplete answers (at least one blank question in blocks 1 or 2), duplicate answers or levels of standardized responses equal or higher than 75 percent (items marked in the same item of the scale). At the end, 243 valid cases remained. Valid responses for the final analysis represent a heterogeneous stratum of RS bodies of direct administration, as shown in Table III.

Finally, the Kolmogorov–Smirnov test conducted with valid data could not determine the sample normality, as presented in Table IV.

Therefore, we chose to use structural equations modeling with partial least squares (SEM-PLS) (Hair et al., 2014; Koufteros, 1999).

### 3.3 Data analysis

We used the partial least squares (PLS) method for data analysis. According to Hair et al. (2014), PLS was developed to maximize the predictive accuracy of models, offering flexibility

<table>
<thead>
<tr>
<th>Construct</th>
<th>Variable</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational citizenship behavior (OCB)</td>
<td>Conscientiousness (CO)</td>
<td>They are sloppy (they do not care if the work is well or poorly done) They are mentally fresh and ready to work as soon as they arrive at the organization They waste time with issues unrelated to the task</td>
</tr>
<tr>
<td></td>
<td>Spirit of Initiative (SI)</td>
<td>They keep informed about what happens in the organization When there are problems, they try to solve them before presenting them to their superiors When something does not work, they look for alternatives to make it work They spontaneously try to improve their knowledge, competences and skills</td>
</tr>
<tr>
<td></td>
<td>Interpersonal Harmony (IH)</td>
<td>They are always complaining about trivial matters (of low importance) They create instability in the team (through gossips and intrigues) When they have unpleasant or difficult tasks to do, they try to &quot;pass the buck&quot; to others They always refer to the negative side of things, more than to the positive side When something negative happens to them, they apologize for others’ mistakes</td>
</tr>
<tr>
<td></td>
<td>Organizational Identity (OI)</td>
<td>They make extra efforts to benefit the organization, even with personal damages In the first place, they think about the activities, more than in themselves When they find out a business opportunity for the organization (even on weekends), they inform the responsible persons</td>
</tr>
<tr>
<td>Effectiveness of IT governance mechanisms (EFF)</td>
<td>ITG Perceived Effectiveness (ITG_PERC_EFF)</td>
<td>IT governance mechanisms provide ICT services with focus on the customer IT governance mechanisms provide integration between systems and processes IT governance mechanisms promote networks of collaboration and diffusion of ICT knowledge Governance mechanisms ensure the optimization of ICT resources ICT governance mechanisms focus on customers’ needs Governance mechanisms promote the integration between different bodies of the State Government</td>
</tr>
</tbody>
</table>

**Table II.** Constructs, variables and factors

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were distributed and collected in person. The answers were then tabulated using Qualtrics® software. As suggested by Hair et al. (2014), data purification was done by removing the cases that had incomplete answers (at least one blank question in blocks 1 or 2), duplicate answers or levels of standardized responses equal or higher than 75 percent (items marked in the same item of the scale). At the end, 243 valid cases remained. Valid responses for the final analysis represent a heterogeneous stratum of RS bodies of direct administration, as shown in Table III.

Finally, the Kolmogorov–Smirnov test conducted with valid data could not determine the sample normality, as presented in Table IV.

Therefore, we chose to use structural equations modeling with partial least squares (SEM-PLS) (Hair et al., 2014; Koufteros, 1999).

### 3.3 Data analysis

We used the partial least squares (PLS) method for data analysis. According to Hair et al. (2014), PLS was developed to maximize the predictive accuracy of models, offering flexibility

<table>
<thead>
<tr>
<th>Construct</th>
<th>Variable</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational citizenship behavior (OCB)</td>
<td>Conscientiousness (CO)</td>
<td>They are sloppy (they do not care if the work is well or poorly done) They are mentally fresh and ready to work as soon as they arrive at the organization They waste time with issues unrelated to the task</td>
</tr>
<tr>
<td></td>
<td>Spirit of Initiative (SI)</td>
<td>They keep informed about what happens in the organization When there are problems, they try to solve them before presenting them to their superiors When something does not work, they look for alternatives to make it work They spontaneously try to improve their knowledge, competences and skills</td>
</tr>
<tr>
<td></td>
<td>Interpersonal Harmony (IH)</td>
<td>They are always complaining about trivial matters (of low importance) They create instability in the team (through gossips and intrigues) When they have unpleasant or difficult tasks to do, they try to &quot;pass the buck&quot; to others They always refer to the negative side of things, more than to the positive side When something negative happens to them, they apologize for others’ mistakes</td>
</tr>
<tr>
<td></td>
<td>Organizational Identity (OI)</td>
<td>They make extra efforts to benefit the organization, even with personal damages In the first place, they think about the activities, more than in themselves When they find out a business opportunity for the organization (even on weekends), they inform the responsible persons</td>
</tr>
<tr>
<td>Effectiveness of IT governance mechanisms (EFF)</td>
<td>ITG Perceived Effectiveness (ITG_PERC_EFF)</td>
<td>IT governance mechanisms provide ICT services with focus on the customer IT governance mechanisms provide integration between systems and processes IT governance mechanisms promote networks of collaboration and diffusion of ICT knowledge Governance mechanisms ensure the optimization of ICT resources ICT governance mechanisms focus on customers’ needs Governance mechanisms promote the integration between different bodies of the State Government</td>
</tr>
</tbody>
</table>

**Table II.** Constructs, variables and factors

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<table>
<thead>
<tr>
<th>Position (no. of observations)</th>
<th>Gender (no. of observations)</th>
<th>Qualification (no. of observations)</th>
<th>Time in organization/sector (average in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technician or Assistant (99)</td>
<td>Male (69) Female (30)</td>
<td>Graduate (55)</td>
<td>12.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specialist (33)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ongoing Master (5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concluded Master (6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concluded PhD (1)</td>
<td></td>
</tr>
<tr>
<td>Analyst (83)</td>
<td>Male (61) Female (22)</td>
<td>Graduate (57)</td>
<td>11.91</td>
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<tr>
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<td>Specialist (38)</td>
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<td></td>
<td></td>
<td>Concluded Master (6)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Ongoing PhD (2)</td>
<td></td>
</tr>
<tr>
<td>Coordinator (22)</td>
<td>Male (18) Female (4)</td>
<td>Graduate (7)</td>
<td>10.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specialist (9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ongoing Master (5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concluded Master (1)</td>
<td></td>
</tr>
<tr>
<td>Specialist (5)</td>
<td>Male (4) Female (1)</td>
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<td></td>
<td></td>
<td>Specialist (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concluded Master (1)</td>
<td></td>
</tr>
<tr>
<td>Manager (27)</td>
<td>Male (22) Female (5)</td>
<td>Graduate (9)</td>
<td>11.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specialist (17)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ongoing PhD (2)</td>
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</tr>
<tr>
<td>Director (7)</td>
<td>Male (7)</td>
<td>Graduate (5)</td>
<td>5.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specialist (1)</td>
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</tr>
<tr>
<td>Total (243)</td>
<td>Male (181) Female (62)</td>
<td>Graduate (115)</td>
<td>11.81</td>
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<td></td>
<td>Specialist (100)</td>
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<td>Ongoing Master (11)</td>
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<td>Ongoing PhD (2)</td>
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<tr>
<td></td>
<td></td>
<td>Concluded PhD (1)</td>
<td></td>
</tr>
</tbody>
</table>

Table III. Characterization of respondents

<table>
<thead>
<tr>
<th>Variables</th>
<th>Kolmogorov–Smirnov (Lilliefors significance correction)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistics</td>
</tr>
<tr>
<td>OCB_CO1</td>
<td>0.215</td>
</tr>
<tr>
<td>OCB_CO2</td>
<td>0.177</td>
</tr>
<tr>
<td>OCB_CO3</td>
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</tr>
<tr>
<td>OCB_SI1</td>
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<td>OCB_SI2</td>
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</tr>
<tr>
<td>OCB_SI3</td>
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</tr>
<tr>
<td>OCB_SI4</td>
<td>0.225</td>
</tr>
<tr>
<td>OCB_IH1</td>
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</tr>
<tr>
<td>OCB_IH2</td>
<td>0.165</td>
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<tr>
<td>OCB_IH3</td>
<td>0.140</td>
</tr>
<tr>
<td>OCB_IH4</td>
<td>0.157</td>
</tr>
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<td>OCB_IH5</td>
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</tr>
<tr>
<td>OCB_OH1</td>
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</tr>
<tr>
<td>OCB_OE2</td>
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<tr>
<td>OCB_OE3</td>
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</tr>
<tr>
<td>EFF_OB1</td>
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</tr>
<tr>
<td>EFF_OB2</td>
<td>0.194</td>
</tr>
<tr>
<td>EFF_PR1</td>
<td>0.169</td>
</tr>
<tr>
<td>EFF_PR2</td>
<td>0.188</td>
</tr>
<tr>
<td>EFF_PR3</td>
<td>0.232</td>
</tr>
<tr>
<td>EFF_PR4</td>
<td>0.183</td>
</tr>
</tbody>
</table>

Table IV. Kolmogorov–Smirnov normality test
for structural equations modeling, since there are no assumptions on variables distribution; thus, there is no need to change the indicators in order to reduce their asymmetry. In addition, the necessary sample size is smaller than in SEM, based on covariance. Analysis in this research stage was carried out through the tool SmartPLS® version 2. To test the relationship between the behavioral dimensions of Organizational Citizenship and ITG Perceived Effectiveness, data were inserted into SmartPLS®. Then, we designed the first-order model, where each of the four variables of the OCB construct was linked to the ITG Perceived Effectiveness construct, as observed in Figure 3.

The analysis of the measurement model began with the assessment of the discriminant validity, achieved as latent constructs or variables showed to be independent of each other (Hair et al., 2014). We verified cross-loadings between the observable variables and their factors, as recommended by Ringle et al. (2014). Table V presents the discriminant validity test, based on cross-loadings analysis (Chin, 1998). Indicators must have higher factor loads in their respective latent variables (or constructs) than in others (Chin, 1998). The second aspect is Fornell and Larcker’s (1981) criterion, in which the square roots of the average variance extracted (AVE) of each latent variable (or construct) are compared with Pearson’s correlations between the constructs. AVE’s square roots should be higher than the correlations between the constructs.

It was possible to determine that the model has discriminant validity, by the results of the cross-loadings analyses, according to the parameters defined by Chin (1998). Results obtained in the convergent validity and reliability test are presented in Table VI. The first item to be observed in the analysis of the structural model refers to the values of Pearson determination coefficients ($R^2$). $R^2$ indicators evaluate the portion of the variance of the endogenous variables that is explained by the structural model, thus indicating the quality of the adjusted model (Ringle et al., 2014).

Table VII presents the values of the Pearson determination coefficients ($R^2$). All tests carried out herein allow us to conclude that the proposed model is suitable for identifying which dimensions of OCB contribute to increase the effectiveness of ITG, in the perception of individuals that work with IT in public organizations. Thus, we calculated the $t$-values between data original values and those obtained by the resampling technique, by using the SmartPLS® Bootstrapping module, a nonparametric procedure in which sub-samples are
created, with randomly drawn observations from the original set of data (with substitution), which allows to test their statistical significance (Hair et al., 2017).

Table VIII shows the effect sizes and the significance of the identified relationships between the variable “ITG Institutionalization” and “OCB variables.”

When interpreting the values of t-statistics and p-value tests, we observe that the values of the relationships between the behavioral dimensions “Spirit of Initiative” and “Identification with the Organization” and “ITG Perceived Effectiveness” are positively significant (Ringle et al., 2014).
4. Results

Higher OCBs increase people’s willingness to make changes in a proactive and receptive way, since a positive and open behavior toward change prevails (Rego et al., 2010). This happens because individuals with high OCB understand that changes are important for the organization. Regarding ITG adoption, research respondents understood the shifts proposed by ITG as positive and necessary to the organization. These changes are usually expressed by the adoption or modification of ITG mechanisms, which ultimately modify the way several IT-related activities are carried out within the IT sector and/or throughout the organization.

Related to the variable “Identification with the Organization” and its positive relationship with the perception of ITG effectiveness, individuals with greater identification with the organization perceive ITG as effective, since they have a predisposition to understand the changes as necessary and beneficial, thus having a more positive view of ITG. On the other hand, individuals with higher initiative understand that they can propose ITG mechanisms, or forms of adoption, and notice that there is room for a joint contribution and definition of the ITG model. Thus, ITG is understood as something that contributes to organize IT activities and the IT sector, rather than an obstacle to the accomplishment of activities.

The behavioral dimensions of Conscientiousness and Interpersonal Harmony did not show significant relationships with ITG Perceived Effectiveness, according to Table VI. We expected that the conscientiousness behavior would have a positive relationship with ITG perceived effectiveness. The fact that employees are aware of their tasks and roles should increase the perception of ITG effectiveness, considering they would understand the organization as a system, and the importance of ITG in the short and long terms. When people show a behavior of avoiding conflict and not upsetting others, which is an attribute of conscientiousness, this should increase the perception of effectiveness due to some mechanisms that contribute to clearer rules, distributive justice and equal treatment regarding how decisions were made (Rego, 1999). For example, ITG works with formal roles and responsibilities that contribute to the arrangement of activities. Accordingly, committees for project analysis (either for execution or financing) stimulate decision making based on objective criteria that apply to all requests, ensuring or encouraging isonomic behaviors. This should reduce resistance because employees would see more equal forms of work in ITG mechanisms, which keep interpersonal harmony by decreasing uncertainties and conflicts in the approval of projects, resources and activities.

However, the expected relationship between Interpersonal Harmony and ITG Perceived Effectiveness was not confirmed; on the contrary, there was a potential negative effect on ITG Perceived Effectiveness. One possible explanation for this fact is that civil servants do not present a high interpersonal harmony behavior, or even do not notice this behavior as a consequence of ITG mechanisms. Another possibility is the presence of self-interest behavior, in which people seek their own satisfaction, most of the time, or have the perception that in the organization each one protects, above all, his/her own interests, trying to get the best for himself/herself (Rego, 2002).

In general terms of the relationship between OCB and ITG perceived effectiveness, other areas end up understanding that the mechanisms are more effective, since the result is better for the whole organization. This occurs especially when employees observe something in a

<table>
<thead>
<tr>
<th>Original sample (O)</th>
<th>Sample mean (M)</th>
<th>SD</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
<th>Significant relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO→ITG_PERC_EFF</td>
<td>0.0499</td>
<td>0.0522</td>
<td>0.0658</td>
<td>0.0658</td>
<td>0.5205</td>
<td>0.6032</td>
</tr>
<tr>
<td>SI→ITG_PERC_EFF</td>
<td>0.4919</td>
<td>0.4915</td>
<td>0.0642</td>
<td>0.0642</td>
<td>7.6661</td>
<td>0.0001</td>
</tr>
<tr>
<td>IH→ITG_PERC_EFF</td>
<td>−0.0935</td>
<td>−0.0826</td>
<td>0.0975</td>
<td>0.0975</td>
<td>0.959</td>
<td>0.3385</td>
</tr>
<tr>
<td>OI→ITG_PERC_EFF</td>
<td>0.1264</td>
<td>0.1264</td>
<td>0.0624</td>
<td>0.0624</td>
<td>2.0233</td>
<td>0.0439</td>
</tr>
</tbody>
</table>
positive way, such as the efforts to help find solutions for other employees’ problems. This happens because individuals from a group with high initiative and high identification with the organization work with others outside their team to solve problems and defend the organization from internal or external threats. They have more initiative or proactivity to solve such problems, including those created by the absence of ITG or by the superficial or inadequate understanding of what it represents in conceptual and practical terms.

In addition, individuals with high OCB take the initiative of explaining the reasons and bases for the organizational ITG model to be in a certain way, raising awareness and advising colleagues in the organization. When users or employees have a better understanding due to OCB, they may notice ITG as more effective, even if no change has been made, because they better understand ITG and its purposes. Hence, individuals come to deeply perceive the organization and the changes proposed by ITG.

5. Final remarks
This research identified a relationship between individuals’ citizenship behavior in an organization and ITG Perceived Effectiveness, in the context of public organizations. It provides practical implications for IT professionals working for the government, and theoretical implications for academics, in the organizational fields of information management and ITG.

The theoretical contribution of the research can be expressed in four ways. The first was the validation of the dimensions proposed by Rego et al. (2010) in the local context. Although there are many similarities between Portugal and Brazil in modus operandi, processes and cultural issues, it was important to validate such dimensions in Brazil.

The second theoretical contribution was the development of a model by adapting already existing scales, with the intention of using it for the analysis of the relationships between individuals’ behaviors and the perception of ITG effectiveness. This model can be replicated in future studies in public organizations and private ones, with the necessary changes regarding the different governance objectives and principles between public and private organizations. The adaptation of this scale can be considered as unprecedented, at national and international levels. Previously developed scales focused on economic/financial aspects and indicators to identify effectiveness, and not on people’s perceptions, which was developed and validated in this research. Considering that an important part of the efforts related to governance is to create appropriate behaviors for each organization, an effectiveness scale with a focus on behavioral variables brings a significant potential contribution.

The third theoretical contribution was to demonstrate the existence of a positive and significant relationship between the variables Spirit of Initiative and Identification with the Organization, and ITG Perceived Effectiveness. It shows that governance is a complex process of organizational change, through behavioral shifts related to decisions, in this case, decisions about IT resources, which are essential for carrying out public strategies and policies. At first, ITG was seen as the adoption of market models, which was a very simplistic understanding. This paper contributes to the maturity of this area by demonstrating that ITG is a complex process of change in IT decision making and its impacts throughout the organization. Thus, ITG increasingly involves the adoption and use of IT in organizations and not just in the IT department, which is the focus of the IT management area. Finally, the study of ITG in public organizations represents the fourth theoretical contribution, since ITG papers in this context are still scarce (Aasi et al., 2017).

As a practical contribution, managers involved in processes of ITG adoption should consider the impact of the resulting change not only in processes and structures, but also in the behavior of individuals in the organization. Given that IT is political and social (Bekkers and Homburg, 2007), ITG adoption changes the meaning of IT in the organization, as it starts to discuss how IT resources should be used to create competitive advantage (Bartenschlager and Goeken, 2010), or public value in the case of public organizations. Hence, the discussion is
no longer conducted by the IT sector, but it is rather about IT, and this understanding contributes to a better establishment of structures, processes and relationship of IT resources' governance (equipment, applications, information and policies, among others).

Another contribution, which can be both practical and theoretical, is the relevance of the organizational atmosphere and people's relationship with the organization, as a relevant component for ITG effectiveness. Studies on the influence of organizational variables for information protection showed that information security policies are less obeyed and followed when the relationship between chiefs and subordinates is not positive or friendly (Johnston and Warkentin, 2010), or if employees do not perceive fairness in the organizations' actions toward them (Garcia et al., 2018). The same happens with the adoption of ITG mechanisms, especially with the “Spirit of Initiative” and “Identification with the Organization,” aspects that were confirmed by this study.

The use of ICT in the public sector can be conceived as a tool to increase trust and promote an inclusive citizen–government relationship, as well as a means for fair ICT policies (Avgerou et al., 2005). This implementation is effective and lasting when part of a process of governance behavioral change. One of the ITG challenges in public organizations is that high-level definitions, such as principles and policies, should be more of a state than of a Government kind; hence, they should not change at each new mandate just to oppose the predecessor. These changes need to be part of a conscientious decision-making process, preceded by discussing and listening to different stakeholders. Thereby, IT actions tend to be more consistent and their implementation more likely to be kept over time, if they are part of an ITG process.

IT managers need to take into account that behavioral changes in individuals, especially those that encourage the Spirit of Initiative and the Identification with the Organization, can contribute in practical terms for the definition of IT policies and ITG mechanisms, and for the establishment of collegiate decision-making structures that are more effective and best protect citizens’ interests in IT decisions, rather than the interests of suppliers, political agents or the IT team itself.

Two limitations are important when interpreting research results. The first regards the predictive capacity of the proposed relationship model, which requires a larger number of confirmatory studies. The second refers to the study's context of application and the coverage of results, since data collection was carried out with civil servants of only one Brazilian state. Application of these results to other states, or even to private organizations, needs to consider geographic, cultural or political issues.

As future studies, we suggest the validation of the proposed relationship model in other Brazilian states or in bodies of the Municipal and Federal Public Administration, which would ensure greater reliability and reach of results. The moderating effect of individual attributes (satisfaction, perception of justice, commitment and trust in the leader), personality (conscientiousness, pleasantness, positive and negative affectivity) or individual competencies and differences (experience, qualification, need for independence and indifference to rewards) can affect the relationship between individuals' OCB dimensions and the effectiveness of ITG models. These attributes can have positive or negative effects on individuals' OCB (Podsakoff et al., 2000), and should be explored in future studies. The variables expected to have a positive relationship with ITG effectiveness – Conscientiousness and Interpersonal Harmony – should also be investigated.

References


Further reading

Corresponding author
Guilherme Costa Wiedenhoft can be contacted at: guilherme.wiedenhoft@pucrs.br

Associate Editor: Adriana Marotti de Mello

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Sustainability in organizational context

Reflections on the meanings attributed to the decision-making process and its strategic implications at Itaipu

Luciano Munck and Maria Fernanda Tomiotto
Centro de Estudos Sociais Aplicados, Universidade Estadual de Londrina, Londrina, Brazil

Abstract
Purpose – Discussions about sustainability in the organizational context present a blind spot. It appears when we ask if a company recognized as sustainable, keep what it means compatible with corporate sustainability premises and its values on the strategic decision process. In this context, the purpose of this paper is, on the light of sensemaking and the decision-making theory, to reflect on possible divergences between meanings attributed to sustainability, available on official documents, and the meanings identified in current actions and narratives related to sustainability goals in the researched organization.

Design/methodology/approach – The research adopted a qualitative approach, characterized as descriptive, using as methods narrative analysis and documentary research, that were carried out from sensemaking theory.

Findings – It was identified coherence between strategic statements and present sustainable actions. However, in view of theoretical reference used, it was identified an imprecision in sustainability perspectives of decision making. Inconsistency tends to promote internal resistance, difficulty to commit to all areas and prejudice long-term results.

Research limitations/implications – Future studies should compare the decision-making meaning attributed to sustainability in companies of different market segments.

Practical implications – The studied case shed light on the importance of managers having at their disposal a map that relates strategic objectives and actions aimed at sustainability. The lack of this compromises the organizational results focused on corporate sustainability.

Originality/value – The understanding of the meanings attributed gives rise to perceptions of possible and relevant flaws in the alignment between the discourse and the practice of sustainability, supporting possibilities of the fine adjustments in strategic decision making.

Keywords Sensemaking, Narrative analysis, Strategic decision-making, Organizational sustainability

Paper type Research paper

Introduction
New ways of understanding and addressing current challenges have emerged from the debate on sustainability that point to a need for managing opportunities and threats in a way that integrates the economic, environmental and social spheres. Managers must now interpret these changes in light of the new basis for decision making, and work on transforming them into opportunities for innovation within their organizations. This shift is driven by the growing support for premises of a sustainable society among parties now critical of “old” management standards based on profit at any cost (Savitz and Weber, 2007; Munck, 2013).
Companies may now issue statements on sustainability, but few are fully focused on actually implementing these principles (Munck, 2015). If we can understand the meanings and relationships between sustainability narratives and practices, we can then build up an identity of a recognized sustainable company, hence the justification for this study. Such an understanding would enable companies to strive toward meeting the conditions identified, after which they will be able to fine-tune their decision-making processes in terms of investments, resources and results.

In order to be perceived as sustainable, companies must develop their decision-making processes, both respecting and adjusting their value systems and organizational arrangements. When companies select a sustainability approach that most conforms to their objectives, purposes and strategies, and begin adapting it to their particular social circumstances, it is natural to review the dominant values of the approach (Munck, 2013; Galpin et al., 2015). However, besides the definition of new visions, the challenge is to integrate traditional concepts of eco-efficiency/environmental management with those of sustainability, and to incorporate the latter into current administrative practice (Elkington, 2001; Hoff, 2008).

To achieve a more flexible and adaptable response to the demands of the macro environment, companies must manage strategies and products so that they meet intertemporal demands: a process that must be underpinned by an in-depth understanding of the past (Bansal and DesJardine, 2014; Munck, 2015; Elkington, 2001). Indeed, whilst decisions are made in the present, they involve a series of comparisons, conflicting interests and differences in terms of past and future: this is the context within which sustainability and strategy converge. Managers, for whom time is always a key factor, understand that the results of sustainability do not always play out in the short term, but concern rather the medium and long term.

In view of the above, it is clear to see the importance of planning and implementing sustainable action within the decision-making process in such a way that there is coherence and consistency between practice and individual understanding in terms of what is considered sustainable. Therefore, our question is: within a company recognized as sustainable, do the values and meanings inherent to the strategic decision-making process also change in accordance with the premises of sustainability?

Rese et al. (2010) pointed out the potential of narratives to define organizational practice and assign meaning to contexts, as a form of reflection on the company’s experience and a means of highlighting subjects’ interactions and conversations. In this way, individuals play a key role in assimilating the sustainability paradigm, as they make up the relevant social networks and the relationships between these, whether on a social, corporate or organizational level (Munck and Borim-De-Souza, 2009a). By interacting with each other, members of the organization interpret their environment and construct explanations for their experience that enable them to act collectively (Maitlis, 2005); and for Daft and Weick (1984), it is the role of managers to interpret, translate and assign meaning to events.

Studies on the strategic decision-making process, organizational sustainability and its respective attributed meanings point to the possibility of identifying key factors in the process of implementing sustainability (Póvoa et al., 2015). However, these factors alone are insufficient, as they rely on decision-making logic associated with sustainability, and managers do not always understand or take note of the meanings attributed to these decisions (Cavenaghi, 2016). A lack of reflection can induce people to associate sustainability and an individualistic vision, related exclusively to the organization’s survival (Silva et al., 2011, 2014).

As Herrick and Pratt (2013) demonstrated, the pursuit of sustainability by companies in the water sector involves a process of broad-scale organizational transformation, perceived as an emerging process that involves a number of deliberate procedures related to organizational factors, social value perspectives and projections about natural and environmental conditions. In other words, sustainable actions comprise new meanings and understandings, both on an individual and organizational level (Munck, 2015; Munck and Borim-De-Souza, 2009a, b).
Therefore, this paper aims to reflect on potential discrepancies between the meaning attributed to sustainability in the company’s strategic framework, and the meaning identified in the sustainability-focused actions outlined in currently active official and narrative documents. We sought to identify and discuss disparities of meaning and their implications for the strategic decision-making process. We used narrative analysis and data obtained from publically accessible materials linked with Itaipu (the company studied) and from semi-structured interviews. We did, in fact, identify a degree of correspondence between statements made during the interviews and the sustainable practices in place. However, in light of our chosen theoretical perspective, some discrepancy was evident between the current and desired decision-making process; a potential source of internal resistance that could compromise long-term results.

**Sensemaking, meaning and sustainability**

The objective of this section is to introduce the concept of “sensemaking” and its main qualifying characteristics as a theoretical alternative for studying sustainability. Careless managers, or those who adhere to the meanings currently prevailing in management, “tend to interpret social and environmental issues through the simple lens of cost and benefit analysis, requiring ‘only’ utilitarian calculations” (Munck, 2015, p. 533). The Triple Bottom Line approach proposed by John Elkington (2001) focuses, instead, on economic, environmental and social analyses; indeed, for the author, performance must be aligned with these three dimensions in order to guide companies toward sustainability.

Assuming that changes in one dimension will have economic, ecological and social consequences for all of them, this shift represents a perceptible development of consciousness. However, the literature examined reveals no single accepted understanding of the term “sustainability,” the meaning of which, therefore, is left to be constructed and created by means of an ongoing process of reinvention dependent on global demands and conceptual change (Herrick and Pratt, 2013; Starik and Kanashiro, 2013; Munck, 2015).

However, adopting a concept of sustainability is no guarantee that an organization is actually sustainable; it is necessary to acknowledge that organizations and individuals depend on the natural environment (Silva et al., 2011). Sustainable management involves more than the attempt to establish accepted meanings; it requires comprehensive approaches that reconcile different visions and respect the different time scales of the social, environmental and economic pillars of sustainable business (Munck, 2015).

This is because sustainable development seeks to achieve a steady balance between social, economic and environmental objectives, as well as to respect their interactions and different timelines; in other words, it serves to provide reference points and calls for strategic decisions in the organizational context to be aligned (Munck and Borim-De-Souza, 2009b). Further factors enabling significant advances in the execution of sustainable operations are the guidelines and values for resolving issues within the internal and external scope of the organization, i.e. different stakeholders (Herrick and Pratt, 2013).

In view of the understanding of sensemaking as an ongoing process that is subtle, swift, instrumental and social (Weick et al., 2005), the concept of building meaning fills gaps and serves as a guideline for action; this is because sensemaking provides the basis upon which meanings may be established, informing and restricting the construction of identity and its actions.

The properties of sensemaking highlighted by Weick (1995) serve as a tool for understanding collective action on an organizational level. Grounded in identity construction: it makes it possible to identify how meanings are constructed based on the past, i.e. it is retrospective; it, therefore, enables the creation of appropriate environments; consequently, sensemaking is social, because it is built around the interaction of individuals; and continuous since environments and perceptions are dynamic; therefore, it is focused on extracted cues; which then become relevant according to the context, i.e. plausibility.
Therefore, in order to deal with ambiguity, individuals seek plausible meanings that allow them to move forward, subjectively perceiving reality as endowed with an objective reality; intersubjectively legitimizing it and attributing it with meaning (Rese et al., 2010; Weick et al., 2005). In this way, organizations can be understood as systems of interpretation, within which managers are responsible for interpreting and translating formerly unnoticed events (Daft and Weick, 1984).

Consequently, sensemaking relates more to the interaction between interpretations than to the influence of current meanings on decision making. However, it is precisely on this point that the present study expands, making the assumption that the meaning attributed to the decision-making process has a significant influence on the effective scope of sustainability; because, in light of the fact that verbalized understanding and company structures have important strategic potential and that, in order to truly be implemented, strategy must be transformed into collective action (Rese et al., 2010), constructing meaning within decision-making processes depends upon the acknowledgment of a complex organizational interpretative framework for interpreting reality (Munck, 2015).

In this way, if organizations are made up of people with different world views, intersubjective engagement between these individuals is required in order to achieve strategic objectives; and, to this end, decisions must make sense for all those involved. Therefore, when addressing sustainability in the organizational context, what emerges is the need to understand the decision-making process in relation to the relevant set of themes and the understanding of meanings and values attributed to sustainability and related initiatives.

The decision-making process and sustainability

This section aims to contextualize the decision-making process within the organizational context and in relation to its links with sustainability. Sustainability and strategy converge principally when it comes to designing products and services to be more flexible and agile, i.e. adapting them to meet the emerging macro demands that arise when managing intertemporal trade-offs between economics, society and the environment (Bansal and DesJardine, 2014).

However, according to Bansal and DesJardine (2014), most strategic management theories are designed to describe initiatives and organizational decisions by analyzing the results on a business level only, ignoring the macro system of which organizations are part. Munck (2015) reported that, by registering and analyzing the dominant logic in the narratives on sustainability, managers can undertake new projects and become agents capable of creating pathways that promote new meanings aligned to the principles of sustainability.

Sachs (1993) proposed four fundamental premises to guide strategies for transitioning toward sustainable development. The first premise is related to time: the author explains that transition strategies must cover a period of 30–40 years, and be structured around a sequence of priorities that change over the years. The second premise states that the more economically developed a country is, the greater its flexibility in terms of fiscal and financial adjustments, and in terms of the production of the requisite technologies. According to the third premise, development initiatives must have a preventive and non-reactive character. Finally, the fourth premise calls for the adjustment of habits, lifestyles and patterns of consumption and production.

According to this approach, sensemaking and sustainability narratives enable the reconstruction of events, making it possible to understand decision-making processes in light of different time frames and to integrate the various dimensions of sustainability (Cavenaghi, 2016; Munck, 2015). This is because spatial and temporal aspects are important in the decision-making processes, and people continually build their realities based on dialogue, interaction and that which they consider to be plausible (Brown et al., 2014). Furthermore, in an organizational context, sensemaking makes it possible to build explanations for collective action, and to support ways of dealing with uncertainty (Maitlis, 2005).
Galpin et al. (2015) emphasized that companies today need a systemic approach to sustainability in order to remain competitive in the long run. According to the authors, when coherent strategies are not developed and capable of supporting the advancement of a sustainable strategy, efforts and action are impaired. Therefore, due to the complex nature of sustainable strategy, managers must take on the challenge of encouraging employees in this respect, and of nurturing an organizational culture that incorporates sustainability.

It is inferred that organizations with the objective of being truly sustainable must understand the spatial-temporal nature of the pillars of corporate sustainability (social, economic and environmental). This means understanding that, although initiatives and decisions begin in the present, meaning in decision making is also subject to what is meant by past and future: these, identified through the narratives in place, explain the directions given to the projects and their effects over time. However, implementing the degree of collective human learning now required by the premises of sustainable development is a time-consuming process, because it must to “reset” the pre-established collective memory by imposing constraints on the immediate needs of businessmen (Munck, 2015, p. 526).

Therefore, the decision-making process with regard to sustainability is made up of approaches and perspectives that make it possible to understand sustainability in an organizational context, and associates these with the relevant time frames. In this regard, Munck (2015) summarized three approaches: the economic radical, which prioritizes financial objectives and prefers strategic cost-benefit relationships; the environmental radical, which rejects human domination over nature; and the integrative radical, which suggests ways to modify our values and articulates a world view centered on reconciling the interests of the three pillars.

In terms of decision-making perspectives, Munck (2015) proposed: the evolutionary perspective, where the path adopted is determined by the initial conditions and external factors pre-designed by the management; the relational perspective, also involving the creation of new interdependent decision paths, but without reflection on the attributed meaning; and finally, the temporal perspective, in which new meanings are required for sustainability and to define what is meant by short, medium and long term.

Table I summarizes the narratives to emerge from the combination of two approaches and perspectives. From here, it is possible to infer that, besides identifying an approach to sustainability in the organizational context, one must also reflect upon the most suitable perspective for the decision-making process. Munck (2015) pointed out that radical approaches aligned with the evolutionary decision-making perspective can be defined as discontinuous and focused on the short and medium term. Meanwhile, integrative approaches associated with relational and temporal decision-making perspectives can support a new meaning that meets the conditions of the dimensions of sustainability in the long term.

It is, therefore, understood that the meanings attributed to sustainability must be narrated and even questioned before understanding can effectively be established, that is, a meaning that will relate to the understanding of the agents involved and respect the challenges in terms of space and time.

Methodological procedures
With the objective of reflecting on the possible discrepancies between the meaning assigned to sustainability in the company’s strategic framework and the meaning identified in the sustainability-focused initiatives outlined in the official active documents and narratives, this study takes a qualitative approach, being reflective and interpretative in nature and encompassing the complex phenomenon of sustainability in the organizational context (Creswell, 2014). Its scope is descriptive, in that it sets out to describe the characteristics of a particular population or phenomenon (Gil, 2006).
To confront the meanings associated with sustainability in the organization studied, narrative analysis was used to understand the organization, since narratives make it possible to organize the organizational practices whilst, at the same time, assigning meaning to certain contexts (Rese et al., 2010; Creswell, 2014). Thus, in view of the fact that organizations and environments must connect in order to exist (Weick et al., 2005), narrative analysis offers an opportunity to understand any deviations in meaning between action and practice, and makes it possible to seek new meanings for the decision-making process in organizations aspiring to be sustainable (Munck, 2015).

In terms of methods, this is a documentary study, in that it seeks to identify meanings attributed to sustainability in the documents available in the public domain (sustainability reports, the Itaipu Electronic Journal and information on the company’s public website). Furthermore, for data collection, this study also used interviews with managers from different functional areas, so that relevant data not described in the documentary sources could be identified, which contributed to our reflection on the meanings identified (Table II).

The company selection criteria were: Brazilian companies that completed the GRI report (Global Reporting Initiatives); with A+ level; recognized as sustainable between 2012 and 2014. The initiatives that corroborate this acknowledgment and demonstrate sustainability as a phenomenon to be managed in the organizational context were: the integration of sustainability into the strategic framework of the company; the presence of committees dedicated to discussing the related issues and sustainability-specific management program; national and international awards for sustainable practices.

Next, we selected managers from various functional areas of the organization, whose work also related to sustainability initiatives. A total of 12 interviews were carried out: 7 in the company’s office in Curitiba, PR and 5 with the employees of Foz do Iguaçu, PR by video conference in December 2015 (Table III).

In order to protect the identity of the participants in line with the confidentiality agreement, the interviews were numbered 1–12 and identified accordingly as “Respondent 1,” etc.; they lasted 28 min on average. For the interview in which recording was not permitted, simultaneous notes were made by the researchers.
This section of the paper will present the analysis and results found according to the objectives proposed and theoretical framework applied.

**Presentation of the organization and strategic reference**

Itaipu Binacional, whose ownership and administration are shared between the governments of Brazil and Paraguay, was founded in 1966 by means of a diplomatic agreement between the countries for energy use in the region of the *Ata do Iguaçu*. The company is not profit oriented, but the annual revenue it obtains from providing electricity services must equal its costs exactly, thereby ensuring the economic-financial balance of the company.
The company’s public documents highlight that, since 2003, sustainability as regards socio-environmental responsibility and development on an economic level and in terms of tourism and sustainable technology was officially included in the company’s mission. In 2005, by means of the *notas reversais*, these initiatives became permanent components of its energy generation activity. As a result of this commitment, in 2010 the company’s “Social Responsibility Council” was created and, in 2011, the group for the development of the “Sustainability Management System” (*Sistema de Gestão da Sustentabilidade* (SGS)) was established (Table IV).

Our analysis of the organization’s strategic framework revealed the mission and vision of Itaipu to have elements that reflect the dimensions of sustainability proposed by Sachs (1993). The company demonstrates concern about economic sustainability, expressed in terms of operational performance; eco-social sustainability, embodied in the social and environmental responsibility the company assumed by embarking on this mission; and spatial and cultural sustainability, manifested in the company’s promotion of development and integration in the surrounding regions of Brazil and Paraguay.

In terms of vision, in the sense of “that which the company intends to achieve,” it was observed that Itaipu’s vision corresponds with the mission in place. Furthermore, we drew from this statement two objectives linked to sustainability, which take both the internal and external environment of the organization into consideration. They are, respectively, by 2020, to consolidate itself as a generator of clean energy with the best operational performance and the best sustainability practices in the world; and to boost sustainable development and regional integration.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Gender</th>
<th>Field of work</th>
<th>Company time (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>General – business planning</td>
<td>5.5</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>General – business planning</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>Financial</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>General – business planning</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>Technical</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>Coordination and environment</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>Financial</td>
<td>4.5</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>Administrative</td>
<td>26</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>Coordination and Environment</td>
<td>7.5</td>
</tr>
<tr>
<td>10</td>
<td>Male</td>
<td>Technical</td>
<td>32</td>
</tr>
<tr>
<td>11</td>
<td>Male</td>
<td>Administrative</td>
<td>28</td>
</tr>
<tr>
<td>12</td>
<td>Male</td>
<td>Legal</td>
<td>29.5</td>
</tr>
</tbody>
</table>

*Source:* Prepared by the authors

<table>
<thead>
<tr>
<th>Mission</th>
<th>“To generate quality electricity in a socially and environmentally responsible way, boosting development on an economic level and in terms of tourism and sustainable technology in Brazil and Paraguay”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision</td>
<td>“By 2020, Itaipu Binacional will consolidate itself as the generator of clean and renewable energy with the best operational performance and the best sustainability practices in the world, boosting sustainable development and regional integration”</td>
</tr>
<tr>
<td>Fundamental policies and guidelines</td>
<td>Respect for human beings; binational integration; innovation; proactivity and innovation; liability and accountability; recognition of the results of people’s work; corporate sustainability; regional sustainable development; and ethical values</td>
</tr>
</tbody>
</table>

*Source:* Prepared by the authors from the company’s sustainability report

**Table III.** Profile of the respondents

**Table IV.** Itaipu’s strategic framework
The preponderant narrative extracted from the respondents’ interviews concerned the company’s mission to generate energy. However, the respondents explain that the organization’s responsibility would not be restricted to its final activity, because the mission itself “[…] shows that we need to integrate the question of sustainability into our practice” (Respondent 6).

They clarify the need for the company to be able to integrate and deal with sustainability both internally and externally. This can be observed in the following excerpt: “Today the company needs to worry about its primary activity, but it must also be concerned with the context in which it is situated. Itaipu stands out because it takes a complex view of its territory on several levels in order to achieve sustainable development” (Respondent 4).

However, the respondents report that they noticed social and environmental action even before any public commitment was made in the company’s strategic statement. From the interview content, we extracted narratives on the development of the surrounding environment: “Itaipu’s social programs are broad in scope: it has done a lot for the region, not only with the expansion of the mission, but through its work, in the region of Foz and Ciudad del Este primarily, as a driver of social development” (Respondent 10).

Galpin et al. (2015) explained that another factor to be considered in relation to companies choosing to adopt a sustainable approach are the values of the company: these are the basis upon which the organization will develop; they serve as the standards and expectations that define the proper behavior of employees in certain situations. At Itaipu, these values are called “Fundamental Policies and Guidelines” and are presented in Table III. It is worth noting that two of them relate directly to sustainability: “Corporate Sustainability” and “Sustainable regional development.”

The respondents pointed out the following values: concern for the environment and bi-nationality, sustainable development, respect for human beings and the participation and involvement of the agents in taking action. “Sustainability is a value […] to seek the development of the plant’s surrounding regions. It is no use being the largest producer of energy in the world, if there is a slum with people starving to death one kilometer away” (Respondent 12).

We recognized the possibility of interpreting these values in an interconnected way, since, from the moment the company became concerned with its surroundings, the parties involved were invited to participate in the subsequent initiatives. In this way, human beings are respected and organizational sustainability is aligned with sustainable development. Moreover, the company’s responsibility in promulgating changes in behavior in accordance with the relevant issues can be seen in the public narratives and in the perceptions of the respondents:

For us, essential values are an absolute must; a sine qua non of a company’s existence […] We must be proactive in our pursuit of sustainability, because sustainability does not exist without the right attitude. For example, the recycling bins are not enough: you need the right attitude in order to throw garbage in the right place (Respondent 4).

This way, it is understood that sustainability, being integrated into the mission and vision of the company, makes action and projects possible, including in the surrounding region, and positively influences the system of which the company is part (Cavenaghi, 2016; Silva et al., 2011; Ostrovski, 2014). It is worth noting that Itaipu’s strategic framework incorporates the dimensions of sustainability linked to sustainable development, associated with strong commitment to conserving and respecting the region, not only in terms of the environment, but of culture as well, since the company is a binational.

**The management model and sustainability management system adopted**

As described in the company’s 2012 sustainability reports, Itaipu uses a “Business Planning and Control System” (Sistema de Planejamento e Controle Empresarial). This management
model, which absorbs the management concepts of the Balanced Scorecard, was adopted to achieve the vision for 2020 and the company’s strategic objectives. To ensure strategy and operation are aligned, and to ensure that resources are managed in a coordinated way, the “Corporate Strategic Map” is divided into sectoral maps, according to levels of superintendence.

The strategic objectives adopted by Itaipu correspond to the themes proposed in its strategic framework and sustainability plan, for example, Objective 3 (“To be recognized as a world leader in corporate sustainability”) and Objectives 9 (“To promote tourism-related development in the region”) and 10 (“To consolidate the process of socio-environmental management by creating a watershed to conserve the environment and maintain biological diversity, whilst also integrating communities”).

Furthermore, the company uses a “Sustainability Management System” (SGS) to manage sustainability on an organizational level. Created in 2012, this encourages participatory discussion to identify and create synergy between initiatives, as well as to disseminate and instill a sense of sustainability among employees. It has its own structure, made up of four dimensions (corporate, environmental, socio-economic and cultural), which support initiatives and do not correspond with the hierarchical structure of the company. However, consultation of the documents revealed the extension of the system to incorporate the Paraguayan side to have only been approved in 2015, giving rise to the “Policy of Binational Sustainability.”

**Sustainable initiatives carried out by the company**

Since 2003, Itaipu has issued an annual “sustainability report.” Between 2003 and 2006, the documents were based on the “Social Balance” model. In 2007, the company adopted the guidelines proposed by the GRI and the electricity sector’s set of indicators. These reports are produced under the coordination of the “Social Responsibility Council” with the assistance of several employees in different departments; the Council contributes in terms of developing initiatives, the results obtained and the level of reporting.

The initiatives/programs highlighted in the sustainability reports consulted are presented in a clear and easy-to-understand way. The data reported are broken down as follows: corporate governance, the economic dimension, the social dimension (society and people management) and the environmental dimension.

The document is subject to external verification and formally presented to those involved with strategic planning and SGS; however, certain limitations in relation to the socio-environmental initiatives and people management can be identified. As explained in the “Reading Guide” at the beginning of the sustainability reports consulted (2012–2014), the initiatives in these dimensions comprise initiatives on the Brazilian side, and so it is not possible to say whether the positive and negative aspects of these initiatives are reflected to the same degree on the Paraguayan side.

In terms of the respondents’ perception of the company’s action for sustainability, the initiatives recalled pertained to the environmental dimension – “Cultivating Good Water” (Cultivando Água Boa (CAB)) and Biomethane – followed by the social – CAB, “Young Gardener” (Jovem Jardineiro), the “Friendly Waste Sorting” program (Coleta Solidária) and by sports. As explained in the interviews, it is not always possible to separate the environmental and social dimensions, since projects like Coleta Solidária have both a social and environmental impact.

These highlights may be associated with the nature of the company, the objective of its initiatives being financial balance rather than profit. For example, only two respondents cited the “Action of Sustainable Purchases,” under the economic dimension. In addition, the prominence given to CAB by the respondents may be related to the award received by the program in the national organization of the United Nations for “Best practices in
water management,” in 2015, the year in which the interviews were collected. However, this does not belittle the relevance and impact of this program.

The CAB program is inspired by the public policies of the federal government and promotes a care-centered ethic, stimulating the adoption of new ways of being, living, producing and consuming. As stated in the corporate documentation, this program has led to a transformation in favor of sustainable development, as it involves community associations, city halls, cooperatives and environmental agencies.

With regard to this same publication, it is noteworthy that, in 2013, the “Production of Energy Supply” dimension was also incorporated. Furthermore, in 2014, development and innovation initiatives were added to this part of the study, such as the “Electric Vehicle” and “Renewable Energy Platform,” which, in previous years, were classified under the environmental dimension.

It was observed that, because the company’s primary activity depends directly on a natural resource (water), there is a degree of interaction between the environmental dimension and the production of energy supply; this is also expressed in the sustainability reports. It is, therefore, noteworthy that socio-environmental responsibility is interpreted as an extension of management, with the company’s concern about the practices and impact of its management being demonstrated in the action it takes; an attribute that differentiates it from other companies practicing activities of an environmental nature without increased commitment (Savitz and Weber, 2007; Hoff, 2008; Galpin et al., 2015).

The meaning attributed to sustainability

The analysis of the company’s public documents – the SGS and fundamental policies and guidelines – revealed that the company defines sustainable action as “economically viable, socially responsible, environmentally correct and culturally accepted.” As for corporate sustainability, this was described as “ensuring that Itaipu’s initiatives are socially fair, environmentally correct, economically viable and culturally accepted, securing the long-term future of the company.”

In terms of the respondents, some of the meanings attributed to sustainability reflected Elkington’s (2001) Triple Bottom Line, such as an emphasis on working toward a state of balance, taking all dimensions into consideration in order to achieve organizational objectives. Others assign sustainability with a similar meaning to that proposed in the Brundtland Report, highlighting the engagement and relative commitment to conducting operations without compromising the ability of future generations to do the same.

Moreover, the interviews also revealed descriptions of concepts that were more particular in nature but related to the integration of sustainability into the organizational context. Among them, those that stand out are: an understanding of sustainability as a sort of competence, which would involve the ability to take a more complex “reading” of the environment, in order to act more safely and make less of an impact; sustainability as a factor that unites people and extremities seeking union; and the association between sustainability and the organization for the purpose of influencing changes in behavior. The following interview extracts elucidate these perceptions:

Explains sustainability using a metaphor, compares it to cement in the structure of the company. Because sustainability must bring together all the loose ends, margins and people, union is needed (Respondent 8).

[…] I think it’s about rethinking […] a change of principles and values, basically, before a change of attitude. The first step towards sustainability is to change yourself: if you change your values and principles, this will be reflected later in your attitudes. And, if it is reflected in your attitudes, it is reflects in your attitudes as a citizen […] (Respondent 6).
what led the company to worry about sustainability was not just the fact that this was an emerging, current and unavoidable issue; the company was also taking its own influential capacity into account (Respondent 7).

What is observed is the existence of concern regarding sustainability associated with the organizational context and with individuals; indeed, as affirmed by Munck and Borim-De-Souza (2009a, p. 3) “the legitimacy of a sustainable paradigm will only happen when human beings, represented as social, economic and organizational agents, validate this whole scenario.”

When asked whether their understanding of sustainability matched that proposed by the company, most respondents said it did. However, they pointed out a limitation in the understanding of sustainability by employees, with the presence of resistance at various hierarchical levels, and a general systemic lack of understanding of the topic.

Póvoa et al. (2015) identified this resistance as part of the process of implementing sustainable corporate management at Itaipu Binacional itself. This process can be divided into two stages. The first, from 2003 to 2006, is identified as a learning process on the significance and implications of engaging in sustainable projects, which at that time were centered on socio-environmental issues and ended up generating a degree of reluctance, being considered a “fad” by certain parties. However, in the second stage, from 2007 to 2012, which saw the adoption of the GRI, the question of sustainability developed an economic dimension, which promoted the understanding of the execution of the initiatives and began a dialogue with society.

The decision-making process in relation to sustainable action

If we consider its insertion into the company’s mission in 2003 by the president of the organization, as well as the subsequent alignment of strategic objectives with it, we might observe that sustainability was integrated as a strategic factor in the structure of the company in a top-down way. Galpin et al. (2015) explained that every successful cultural shift involves approaches at various levels of the organization, and sustainability is no exception. Accordingly, as regards the sustainability reports, the creation of the SGS and the systematization of action in the form of projects, it may be observed that the implementation of sustainable initiatives prioritizes interdisciplinarity and horizontal integration among the individuals in the organization.

However, during the interviews, when asked about the aspects considered during the company’s decision-making processes in relation to sustainability, there were divergences in the responses of the participants. For some, economic, social and environmental aspects were considered equally important. However, others perceived that, at certain times, social and environmental aspects stood out and, at others, economic matters were more prominent.

The respondents emphasized that “economic,” for the company, means the economic-financial balance of its activities, not being driven by profit. However, this makes it necessary, for certain decisions, to opt for the alternative that provides the most noticeable results, usually measured quantitatively over a restricted period – short/medium term:

[…] because we deal with public money, we need to be very careful, because when investing in innovative projects there is always a risk factor, which is not always possible to measure, because there are things that can cost more or even make the project impossible. Therefore, whilst Itaipu Binacional is a development proponent, it is also questioned about its investment in socio-environmental issues (Respondent 2).

At the level of strategic planning, I still notice a tendency for the financial, the economic. […] the priority in the allocation of resources is for things that have a result people can see, but in terms of change, this is not always possible […] with culture, the result will be medium and long term. […]
But, the fact of having the concept of sustainability in the mission and a system linked to strategic planning is already a huge opportunity, because it is stated; it is written (Respondent 6).

I think the social and environmental part is even the highest priority, maybe. But of course, I don’t mean that Itaipu is irresponsible and doesn’t measure value, but it really thinks a lot; if something is good, then we’re going to invest, we’re going to do it (Respondent 11).

Regarding the criteria and choices related to the decision-making process as regards sustainability, the following aspects were identified in the interviews: the relationship between the executed action and the intended action, strategic alignment and the impact it generates. It was cited that an initiative is expected to reach a certain level of maturity before a new one may begin. The company also tries to identify how a new initiative might contribute to those already underway:

We look for those decisions that would contribute the most to the initiative or program that is already established […] It would not be right to start another project without the former being consolidated in this pre-established structure, so we seek to optimize what already exists (Respondent 3).

As regards classifying initiatives by their relative dimension, as had been explained, it is not always possible to completely separate them, because at times they come under more than one dimension, for example, both environmental and social, “[…] Every initiative in one dimension or another ends up having repercussions on or interaction with other dimensions. So, when we think, we categorize it according to the scope that best corresponds and check its relationships with the other dimensions” (Respondent 1).

We can, therefore, infer that there is a certain logic to be followed in decision-making processes that regard sustainability. However, they are not always perceived in the same way by those involved, as biases exist that interfere with human behavior, and each situation has its own distinct characteristics. At the same time, taking Table I as an example, it was noted that some reports demonstrate a tendency toward an integrative approach, while others may be classified as falling somewhere between the environmental and economic radical, as in Table V. In terms of timeframe, evaluations are predominantly

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Approach</th>
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</thead>
<tbody>
<tr>
<td>Evolutionary: the sustainable initiative was inserted in the context of the company in order to comply with the mission assumed since 2003 and the public policies adopted by the government</td>
<td>Environmental radical: early stage. At first, initiatives focused on the environmental and social aspects. As of 2007, with the adhesion to the GRI model, the economic dimension was included in the company’s sustainability reports</td>
</tr>
<tr>
<td>Relational: the SGS proposal does not conflict with the organizational structure in place in the company, In addition, the programs/initiatives carried out by the company are designed to involve several agents, both internal and external to the organization</td>
<td>Economic radical: the need to quantify/measure the results of action as a justification for the execution of projects</td>
</tr>
<tr>
<td>Temporal: the company’s vision is based on the year 2020. Therefore, it is not possible to state that the temporal perspective is considered in the long term. In addition, it should be noted that some corporate governance positions are appointed by the governments of both countries, which would not necessarily guarantee the continuation of these initiatives with the same intensity and management focus</td>
<td>Integrative: strategic reference. As noted in the reports, the mission, vision and values of the company are directed toward sustainability</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors from Munck (2015)
short and medium term in scope, considering that the company’s vision is outlined as far as 2020 and that the outcomes of actions should be evaluated quantitatively.

As regards the positive aspects of sustainable action, respondents reported that benefits include the following: they create a staff body with an enhanced world view, who promote sustainability outside the organization as well; pioneering action to enhance and empower the region, which promotes development; more operationally efficient; acknowledgment of society; the influence and impact of activities have a broader impact; and the scope of the corporate vision.

In terms of the negative aspects of sustainable action, respondents said they struggled to see any, identifying a number of challenges instead, among which they highlighted: internal resistance to cultural change; people’s awareness; measuring the results of initiatives; the cost of initiatives (since, in certain circumstances, the short-term costs are high and the company must ensure its economic activity remains balanced); and, working with society, because you have to demonstrate the limits of the company’s activities to society, as well as listen to society before launching any initiatives.

When asked about the benefits and challenges of sustainable action, the narratives of the respondents show that, whilst the company is choosing to implement these initiatives, there is a degree of internal resistance to change that must be worked on. This resistance can be minimized by illustrating and highlighting to employees the results that the company obtains by adopting a sustainable approach. In this way, the tendency is for them to understand that impacts take place both inside and outside the organization and, therefore, interaction and cooperation between the actors involved, the stakeholders, is important (Osorio et al., 2005).

Póvoa et al. (2015) noted that, despite the fact that Itaipu employees were trained and qualified, resistance to change consisted specifically in incorporating the principles of a sustainable management model, constituting a significant obstruction to the sustainability program. This challenge reflects the nature of sustainability itself: as it transcends the “fad” phase, a whole new paradigm is developing that recognizes systemic complexity and the inequalities and imbalances that can compromise sustainability (Bansal and DesJardine, 2014).

Therefore, it is possible to identify the need for greater understanding of the meanings attributed to sustainability among employees in different hierarchical positions and functional areas, particularly in view of the fact that sustainability requires an adaptable and flexible management team capable of supporting conscious processes that respect learning cycles and technological, procedural and political feasibility (Herrick and Pratt, 2013). The perception of the meanings associated with sustainability among individuals in the organization form the basis upon which to implement initiatives that direct and strengthen the identity of a sustainable company (Munck and Borim-De-Souza, 2009b; Rese et al., 2010; Brown et al., 2014; Munck, 2015).

Final considerations

Returning to the question that guided this study – whether, in a company recognized as sustainable, a change of values and meanings in the strategic decision-making process also occurs to align them with the premises of sustainability – it was possible to infer, from the narratives presented in Itaipu’s decision-making process, the predominance of the environmental radical approach, oriented by a relational perspective, placing the company exactly in the central region of Table I.

The sentences that describe the mission and vision of Itaipu present a meaning attributed to sustainability similar to the one proposed by Elkington (2001) and Sachs (1993), involving the spatial, cultural, social, environmental and economic dimensions. These perspectives support the sustainable actions of Itaipu, as reported on the model proposed
Sustainability is inserted in the strategic framework (Galpin et al., 2015), but it is not possible to say that all dimensions are understood and considered with the same relevance or concurrency.

The environmental radical approach is very close to the context of the organization’s performance and is present since the early stage of the formal adoption of sustainability in the public declaration of the company’s mission in 2003. In addition, it is associated with the direct impact that this dimension exerts on the company’s primary activity, because for the hydroelectric plant to achieve its vision, Itaipu Lake must be preserved.

The execution of initiatives depends on the involvement of different agents, but the need to quantify the results, to justify them, prioritizes benefits in the short and medium term. At this point, we can identify a relational perspective, and the time factor, highlighted as one of the fundamental elements for sustainability (Munck, 2015; Bansal and DesJardine, 2014; Sachs, 1993), can be compromised, particularly impairing long-term organizational sustainability due to the pursuit of more obvious results in the short and medium term.

In light of our results, and considering the framework proposed by Munck (2015), it has been observed that Itaipu is in a phase of renewal, whereby sustainability is gradually being integrated into management and decision-making processes. The respondents show knowledge of sustainability and its pillars, but they differ in terms of the respective prominences of each one in the decision-making process. It is possible to identify, based on the interviews, reflections on the current meaning, but there is also an absence of consensus to guide the decision-making process.

The coexistence of several approaches to sustainability is a factor that influences internal resistance to the integration of sustainability into the organizational context. This realization presents consistent information on the path that the organization must follow until it reaches a consensus on its narrative for sustainability, as proposed in this study, which is the convergence of an integrative approach with the temporal decision-making perspective (as shown in Table I), considered ideal as a guideline for organizations wishing to achieve sustainability in its most comprehensive form.

Therefore, adopting an understanding of strategic action as something that people and organizations perform and not as something organizations have (Rese et al., 2010), the decision makers and agents involved may experience difficulties in prioritizing sustainability-related goals and actions if these are understood in the same way. Therefore, this confirms the importance of understanding the processes of building meaning – sensemaking – to make the meanings attributed to sustainability understood, and to change them if necessary.

Based on interaction with the different actors involved, one can mitigate possible conflicts of interest between the functional areas and projects focused on sustainability, as well as make employees understand why they should or should not adhere to sustainability in the organizational context in its fullest sense (Weick, 1995; Daft and Weick, 1984; Weick et al., 2005). Accordingly, “it would not help the director of marketing and sustainability to say that he is acting from an integrative and temporal perspective, if the financial and operational areas are acting from an economic radical and evolutionary perspective” (Munck, 2015, p. 534).

We note the need for timely action, particularly with the internal public, aimed at disseminating and building meanings attributed to sustainability that are plausible for the majority of employees; as well as at coordinating and evaluating approaches and perspectives that guide the decision-making process with regard to sustainability. In this particular case, it is observed that Itaipu has at its disposal a map illustrating the dominant narrative as well as the means of achieving an integrative and temporal approach for its decision-making process.
As a suggestion, future studies should compare the meanings attributed to sustainability in relation to decision making in companies from different market segments and, even, in different functional areas and hierarchical levels. These data would encourage the adhesion to sustainable initiatives by also contesting meanings adopted in relation to organizational outcomes (financial, clients, etc.).

References


Further reading


Corresponding author

Maria Fernanda Tomiotto can be contacted at: mfernanda.tomiotto@gmail.com

Associate Editor: Felipe Lara

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Circular economy: analysis of the implementation of practices in the Brazilian network

Flavia Cristina Silva  
*Universidade Presbiteriana Mackenzie, São Paulo, Brazil*  
Fabio Ytoshi Shibao  
*Universidade Nove de Julho, São Paulo, Brazil*  
Isak Kruglianskas  
*Faculdade de Economia e Administração, Universidade de São Paulo, São Paulo, Brazil*  
José Carlos Barbieri  
*Fundacao Getulio Vargas, São Paulo, Brazil, and*  
Paulo Antonio Almeida Sinisgalli  
*Universidade de São Paulo, São Paulo, Brazil*

**Abstract**

**Purpose** – In total, 19 practices of circular economy divided into three groups, internal environmental management, ecological design and investment recovery were studied in a local network composed of small companies and individual entrepreneurs related to common product and by-product flows. The paper aims to discuss these issues.

**Design/methodology/approach** – This research presents an applied nature, is characterized as exploratory and adopted the case study as a technical procedure using sources and methods of data collection. The primary data were collected through direct observation of the processes and semi-structured interviews with managers and owners.

**Findings** – The most widespread practices are related to product design. However, in most cases, the implementation was punctual and did not present continuous and corresponding actions, which highlights the embryonic contours of European Commission (EC) in the observed network. The practices from the management category were less observed, which reveals the environmental variable is not included in the strategic business planning.

**Research limitations/implications** – The research documents the application of CE practices in a local network and brings this current paradigm shift to the Brazilian context.

**Practical implications** – To overcome barriers to the implementation of EC practices, it is suggested to restructure commercial relations, to formulate public policies and to develop infrastructures that facilitate the materiality of flows and the market.

**Social implications** – The study highlights the need of public policies that promotes cross-sectoral cooperation in accordance with NSWP objectives.

**Originality/value** – Despite the focus on EC implemented practices this study offers a framework of the research routes on the main barriers and suggests actions to overcome the challenges in the transition from the economy to the circular model.

**Keywords** Barriers, Waste management, Case study, Circular economy (CE), Environmental management

**Paper type** Research paper

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1. Introduction

The patterns of production and consumption have put substantial pressure on the environment. This fact has created the risk that the absorption capacity of the planet will be compromised and the threat of ruptures in breaking ecological stability due to the accumulation of pollution. Global sustainability depends on the dissociation of the rates of economic growth and resource consumption, so that productivity can be achieved through technological, relational and institutional innovations (Fischer-Kowalski and Swilling, 2011).

Agenda 2030, an agreement signed by more than 190 countries, includes 17 sustainable development goals (SDG). Among these, SDG 12 proposes to assure sustainable production and consumption standards. Moreover, this agreement establishes several goals, such as sustainable management, efficient use of natural resources, mitigation of pollution and its impact, the implementation of practices that prevent the generation of waste, and the prioritization of reuse and recycling processes (UN General Assembly, 2015).

The role of the governments associated with Agenda 2030 is to elaborate public policies that involve the manufacturing and agriculture sectors of society in order to meet the goal of reducing the amount of waste generated. In addition, the role of companies encompasses committing to sustainability, adopting new perspectives, realigning their business models and acting interdependently (Cepal, 2016).

Cooperation among companies is established by relationships that integrate environmental actions between suppliers and consumers. Moreover, it is the task of research to highlight that these integrated environmental actions have economic and political relevance (Ioppolo et al., 2014).

The literature presents a profusion of studies related to the topic of cooperation among companies, which is carried out mainly in developed countries. However, with regard to Brazilian companies, the transition to sustainable production requires methodologies and practices adapted to the local reality because of the lack of structure and training (Gomes et al., 2013).

The CE proposes to reduce the environmental impact, and at the same time, promote economic growth through business development and new revenue streams (Kalmykova et al., 2018). As a system that minimizes waste generation and emissions, and mitigates material and energy loops to preserve resources, CE can contribute to sustainability through conditional, beneficial or trade-off relationships (Geissdoerfer et al., 2017). Like environmental sciences and sustainable development, CE is aimed at helping to resolve environmental issues (Sauvé et al., 2016).

This study aimed to analyze the implementation of CE practices in a network of individual entrepreneurs and small companies that participates in flows of products and by-products in common.

In addition to this introduction, this paper includes five other sections. The theoretical foundations that underlie this study are presented in Section 2, while Section 3 describes the research in terms of its methodological procedures. Further, the results are reported and discussed in Section 4. Finally, the fifth section presents the final considerations, the contributions and limitations of the research and suggestions for future studies.

2. Literature review

2.1 The roots of the CE

As highlighted by Merli et al. (2017), CE is a concept that shares many common principles with others, including industrial ecology (IE). It emerged as connected IE, which is particularly related to the exchange of the by-products and waste that are mirrored in the natural cycles of material and energy (Gregson et al., 2015). The IE concept is described as a multidisciplinary study of industrial and economic systems and their links to essential natural resources (Allenby, 2000).
In the biological sciences, the term symbiosis is used to describe a type of interspecific harmonic relation that brings benefits to living organisms (Odum and Barrett, 2011). Similarly, IE employs the term industrial symbiosis to describe the organizational interactions related to resource and waste recycling (Lifset and Graedel, 2002).

The use of the biological analogy by IE suggests that concepts such as recycling and load capability linked to the basic characteristic of an industrial ecosystem consist in the resilience, or in other words, the ability to interact with the environment and enable its regeneration (Ehrenfeld and Gertler, 1997). The key elements of IE are the biological analogy, system perspectives, technological modifications, cooperation, dematerialization, eco-efficiency and research and development (White, 1994). IE can be stratified by the extent of the interactions. The first aspect refers to the degree of dependence on natural ecosystems in relation to the resource supply, as well as the waste and emissions disposal channels, and the level of impairment of the load capability of the planet; moreover, it is divided into elementary, intermediate and self-sufficient models (Jelinski et al., 1992; Lifset and Graedel, 2002).

There are at least two ways in which IE themes can be incorporated into a larger whole. One way is to view IE as operating partly at the firm or the unit process level (design for the environment, pollution prevention, eco-efficiency and “green” accounting), at the inter-firm (eco-industrial parks [industrial symbiosis], product life cycles and industrial sector initiatives), district or sector levels, and finally, at the regional, national or global levels (budgets and cycles, materials and energy flow studies and dematerialization and decarbonization). While the firm and unit processes are relevant, much of IE focuses on the inter-firm and inter-facility levels, because pollution prevention or related aims address many of the significant issues at the firm, facility or unit process levels (Lifset and Graedel, 2002).

Another way to link the elements together is to see them as reflecting the theoretical aspects of IE in many of the interdisciplinary aspects of the field (systemic analysis of resources and social and economic), while according Lifset and Graedel (2002), the more practical and applied aspects appear in ecodesign.

IE provides a beneficial and inclusive economy by focusing on minimizing resource consumption and waste disposal (Andersen, 2007). Like industrial symbiosis, urban symbiosis can also contribute to strengthening the CE by means of transforming physical resources into economic benefits (Su et al., 2013; Wen and Meng, 2015).

As highlighted by MacArthur et al. (2015), circularity is deeply rooted in history, and CE correlates with several schools of thought. In the concept of cradle-to-cradle, CE seeks to avoid the final disposal of products and promote the recycling of materials, transforming them into inputs and raw materials (McDonough and Braungart, 2010).

Economic performance contributes to the CE through principles such as the manufacturing of durable products and focusing on maintenance services that allow the extension of the useful life of the products (Stahel, 2010). Moreover, regenerative design has influenced the CE in relation to the rational use of natural resources with the aim of avoiding their depletion and environmental degradation (Cole, 2012; Lyle, 1996).

For the CE, natural capitalism proposed the perspective that biotic and abiotic resources constitute the world’s inventories of natural assets (Hawken et al., 2013); however, the blue economy suggests that energy sources should be regarded as a keystone of economic systems, which should be limited to the ecological conditions of the environment in which they are inserted (Pauli, 2010).

Biomimicry or biomimetics is recognized as a principle compatible with the CE because nature is taken as a model of design (Pomponi and Moncaster, 2017). For example, some lessons interpreted by Bhushan (2009) include the chemical energy conversion by plants, the energy production by aquatic animals, and reversible adhesion in dry and wet environments by insects, reptiles and amphibians.
The CE is a divergent concept in the literature stemming from several epistemological fields (Homrich et al., 2018). Many other correlations could be established among the CE and the major environmental concepts that have emerged in the past, including the green and bio economies. As D’Amato et al. (2017) showed, those concepts were postulated by a pool of social players such as academics, NGOs, industries and policy makers and their definitions overlap.

Kirchherr et al. (2017) identified 114 different definitions for CE, highlighting the lack of consensus. The CE refers in practical terms to reuse at three levels: the product level, such as repair or refurbish; the component level, such as, for example, remanufacturing; and the material level, which is regarded as recycling (Zink and Geyer, 2017). The CE proposes the arrangement of a system in which the efficiency of the use of resources is increased. In addition to being reduced, waste is used as a source of material and inputs for companies organized in networks that is unlikely in the linear economic standard of the consumption of resources, production and disposal (Geng et al., 2016; Koci et al., 2016). Despite the originality of the concept, proponents emphasize that the most significant contribution of the CE is the combination of different strategies from past attempts in a new framework (Bocken, Olivetti, Cullen, Potting, and Lifset, 2017).

2.2 Drivers and barriers to CE

The evolution of the CE concept has been shaped by different cultural, social and political aspects (Yu et al., 2015). For instance, while China adopted the CE as a top-down strategy of development and as a control instrument, the European Union, North America and Japan have approached this concept as a bottom-up policy (Winans et al., 2017).

At the end of the 1990s, the CE was inserted in Chinese public initiatives by means of policies to support research, articulations between stakeholders and the implementation of eco-parks, and was focused mainly on waste recycling (Yuan et al., 2006). The second phase of expansion, which was based on the lessons learned from the problems of technical unfeasibility and economic difficulties, redirected the focus of the CE to the industrial structure (Geng et al., 2016; Yuan et al., 2006).

Regarding the early application of the CE, China was the leading country in terms of publications, while in publications from Europe, the usage of the term CE became more common after the European Commission (EC) addressed the issue of waste in 2014 (Türkeli et al., 2018).

The EU started the transition with the publication of the Circular Economy Action Plan in 2015, which preceded the environmental directives EC 2005, EC 2011a, EC 2011b and EC 2011c. The EC framework was based on eight building blocks: industrial symbiosis, material resource efficiency, product life-cycle extension, biological products, energy efficiency and renewable energy, the performance economy, the sharing economy and finally, the platform economy (Taranic et al., 2016).

Despite divergences in governance paradigms and context, China and Europe are the forerunners in the CE; the evolution of the concept in each of the regions can provide lessons for the other. According McDowall et al. (2017), China encourages and coordinates the transversal development of the CE through zones, regions and cities, where leading firms and institutions are the focus of different administration programs, such as experimentation and the coordination of management; further, the Chinese approach to the CE includes land-use planning.

On the other hand, Europe has provided a model of product labeling requirements that has been followed by a substantial number of countries, as has its product standards and experiences with the eco-design process and the promotion of business model innovation. In addition, McDowall et al. (2017) highlighted the possibility for synergy between the two areas.
In Brazil, the CE is supported by the National Solid Waste Policy (NSWP) (Brazil, 2010), which institutes a shared responsibility policy for the product life cycle and establishes reverse logistics as an instrument of economic and social development through an environmentally friendly waste disposal process (Azevedo, 2015; Demajorovich and Migliano, 2013). Although it is a beginning, the approach to waste management represents a small part of the potential of the CE, which incorporates effective proposals for resource management, such as regenerative design (Lyle, 1996), economic performance (Stahel, 2010) and a cradle-to-grave approach (Braungart and McDonough, 2009), among others.

In addition to environmental reasons such as resource scarcity stemming from unsustainable patterns of production and consumption, the economic benefits from new markets is a relevant driver for the transition to the CE (MacArthur et al., 2015). The literature proposes a large number of new possibilities for business models, for example, the integration of key stakeholders and data in the development of CE strategies (Jabbour et al., 2017). Other strategies include remanufacturing and sharing models (Bocken, Ritala, and Huotari, 2017).

In the literature, the formulation and application of the CE concept is considered fragile because of the lack of methodological cohesion in the criteria for measuring results (Bjørn and Hauschild, 2013). The proposed solutions to this problem include the adoption of effective indicators of waste reduction (Veleva et al., 2017), life cycle assessment (LCA) methods for the design and measurement of performance (Scheepens et al., 2016), and streamlined life cycle analysis, which is a quicker and cheaper approach than LCA (Gnoni et al., 2018). Furthermore, the focus on the production and services system aligned with environmental preservation is not related to the social dimension or to the results that can be expected in terms of balance (Murray et al., 2015).

The CE’s focus on waste management also generates disapproval from part of the scientific community because of limiting conditions such as the unfeasibility of the reuse, recycling or recovery of certain types of waste, either for technical or economic reasons. The quality and quantity of recovered materials is a critical aspect for the stock supply of a growing economy, as well the energy required for transformation, and because primary resource extraction is necessary for all economies (Cullen, 2017; Lèbre et al., 2017; Murray et al., 2015).

As a social phenomenon, the CE finds limitations in the biological, chemical or technical concepts for matching materials appropriately, mainly those regarding the management of hazardous or potentially hazardous substances embedded in material cycles (Bocken, Olivetti, Cullen, Potting, and Lifset, 2017). An overview of the CE concept by Korhonen et al. (2018) highlighted that the complexity of material will be increased with new usages and combinations, because the environmental impact assessments of biofuels, biomaterials and other eco-efficiency initiatives remain incomplete due to unsolved methodological issues and other limitations.

The CE concept has gained momentum over time among private and public institutions; however, there are several challenges the concept must overcome to move society toward sustainability.

3. Research design

This research presents an applied nature and is characterized as exploratory, because it intends to approach the theme, as well as to solve specific problems, by performing an intensive analysis of an individual unit, such as a person or community, stressing developmental factors in relation to the environment (Prodanov and Freitas, 2009). In relation to the operationalization of the research, the significance of the condition of the contexts in which the players are inserted favored the choice of the case study as a technical procedure (Yin, 2015).

Among 32 pallet manufacturers that were contacted by phone, 26 agreed to respond to the questionnaire regarding the implementation of the CE practices presented in Table I.
The scientific production regarding the CE has increased significantly in recent years. A search in the Scopus database using the term “circular economy” in the article titles, limited to 2016 and 2017, produced 367 papers. Nevertheless, this research followed the premises that were validated by Zhu et al. (2010) in a study conducted in the Chinese industrial sector with more than 300 companies.

Although the study that supports this research was developed at the early stage of the CE in China, its framework is supported by recent empirical research, such as a case study developed by Manninen et al. (2018) among share and regenerate firms in Finland, as well as the review conducted by Petit-Boix and Leipold (2018) about the implementation of circular economy practices at the city level. Similarly, in Brazil, Sousa-Zomer et al. (2018) adopted the same nature of practices in a case study to provide evidence of the linkage between the CE and cleaner production.

From 14 valid questionnaires that were answered, this study identified that the number of practices implemented ranged from two to ten. In addition, the majority of companies (64 percent) adopted up to five CE practices in their processes. The companies that identified the highest number of practices were contacted again; however, only the firm identified as Alpha Company agreed to participate in a qualitative survey.

Alpha Company and other firms are identified, and all of them became players in the network shown in Table II. They are located in Ibiúna City, which has an economy mainly based on agricultural production and supplies the metropolitan region of São Paulo with several horticultural products.

Alpha Company belongs to the mechanically processed wood products sector. This company manufactures pallets from lumber. Besides the product, the outputs of the process are three by-products: residues resulting from the processing of wood logs, wood shavings (by-product 1) and sawdust (by-product 2), differentiated by the granulometry, and the secondhand clapboard sidings (by-product 3) in the assembly phase of the pallets.

These by-products are absorbed as inputs in other processes and circulated among various supply chains. Figure 1 describes the relationship among the players, focusing on the flows and transformations of the by-products of Alpha Company.
3.1 By-product 1 – wood shavings
According to Brandt et al. (2002), each 1 m³ of dry and classified wood sawn consumes 2.62 m³ of logs with bark. The chips resulting from the initial processes, such as debarking, unfolding and planning, are known as wood shavings. After they are driven by a treadmill out of the productive area and stored outdoors, the wood shavings are acquired by Entrepreneur B and resold to Gama Company for cage lining. After 49 days, when the breeding cycle ends, and the poultry are slaughtered, the shavings and the wastes they absorbed, now called chicken litter, are taken out by Entrepreneur B and resold to Farmers 1 and 2.

3.2 By-product 2 – sawdust
The waste, in the form of a powder, is collected by mechanical mats in the vertical, horizontal and refill sawing stages. The sawdust is stored in a protected place and sold to...
Beta Company, which presses it under high pressure to obtain the briquettes. These cylindrical blocks of high calorific value are sold to Retailers A and B for the maintenance of ovens and wood stoves.

3.3 By-product 3 – secondhand clapboard siding

In the assembly phase, slats that have defects are segregated because they cannot be used in the manufacturing of pallets. This material is purchased by Entrepreneur A and transformed into household goods such as boxes that are sold to Farmers 1 and 2 for the packaging of hardwood and beekeeping.

Alpha Company, Gama Company and Retailer B are classified as small-sized companies according to the Brazilian Service for Supporting Micro and Small Enterprises (SEBRAE, 2016), and Beta Company and Retailer A are micro-sized enterprises. Entrepreneurs A and B are self-employed, while Farmers A and B operate under the cooperative regime, respectively, registered to family agriculture and organic agriculture programs. In a comparison of this framework to guidelines such as ReSOLVE proposed by the Ellen MacArthur Foundation, it is possible to identify two of six business model strategies as follows: the regeneration strategy corresponds to the flows of Alpha’s by-products among the other players; and the loop with the restoration of the organic value of the chicken litter.

A cross-sectional perspective was adopted to portray the specific period from August to December 2017. The collection of the data, which utilized multiple sources and varied methods, allowed the mapping of the process and the by-product flow, as well as the identification of the network of players involved, as was presented in the previous section.

The primary data were collected through direct observation of the processes and semi-structured interviews with managers and owners. Secondary data were obtained by consulting various records, such as forestry origin documents, operating license waiver certificates, material and input purchase requisitions, material entry and exit reports, environmental labels, procedures, and safety information sheets of chemicals, among others.

Only the CE practices evidenced by three different sources, as suggested by the methodological triangulation described above, were considered implemented as presented. They are discussed in the next section.

4. Analysis and discussion of results

The industrial system is considered the producer of both products and waste. With this approach, the limits of a company are extended to the environment, requiring that products and waste should be developed and discussed among different companies (Zaneti et al., 2009). The players are integrated in a network in which individual entities become engaged in transactions for resource exchanges of materials, energy or by-products at the inter-firm or same level as described by Ghisellini et al. (2016).

In terms of special conditions, although the players are not placed within strict boundaries like a park, they are geographically close enough to promote circularity and to take advantage of the exchange of material and energy flows. According Chertow (2012), this type of symbiosis occurs among regional firms.

The participation of all the players constructs the network with originality and exclusivity. As argued by Domenech and Davies (2011), the network morphology is determined by the density and connectivity of the players.

Figure 2 shows the implementation of CE practices quantitatively. Although the intentionality in the network formation was observed, and although the players emphasized the importance of the circularity of materials, the findings showed that the players implemented less than 50 percent of the actions, so that the minimum verified was two practices and the maximum was ten.
In terms of quantity, Alpha Company and Farmer 2 presented the highest results, with ten practices each, while Entrepreneur B presented only two. A single practice was common to all players; P12 is related to the design of products for the reuse, recycling and recovery of materials of component parts.

The process of producing organic vegetables is aligned with environmental protection from the preparation of the land to the delivery of the product; as Farmer 2 reported:

[...] we do not use pesticides and chemical fertilizers. For instance, the planting accompanies the unevenness of the land to avoid erosion, the irrigation method is economical and supplied with rainwater; moreover, we generate solar energy, and the transport of the products is associated with the other cooperatives.

Patterns of the comprehensive utilization of water and energy, as well the principles of ecology and sustainability are predicted for circularity in agriculture (Xuan et al., 2011). Farmer 2 emphasized that a hindrance to the full conversion to the CE is the low investment in technology and infrastructure, and the need for technology transfer was pointed out by Xi (2011) in a study about the models of the CE in agriculture.

The manager of Alpha Company highlighted the strategies that produce sustainability:

Because of the quantities generated, we prefer to market the by-products rather than process them. This fact is relevant for middlemen because it fosters the economy. For us, it also recovers investment and reduces losses, allows us to optimize the process and keep focused on the product, which guarantees reaching more customers.

The lack of awareness of society regarding the consequences of current development standards is one of the obstacles to sustainability (Jacobi, 2003; Jacobi and Bensen, 2011). The pressure of customers is a driver for CE transition (Moktadir et al., 2018). According to Entrepreneur B, CE practices are not applicable to all markets:

I saw the opportunity to sell a service instead of charging only for the freight. In addition, I started to buy the sawmill and sell it to the farm with the guarantee of withdrawal. For the customer, the service is convenient and the price advantageous. For me, it is an investment because I make a profit when I sell the chicken litter to the farmer. Nonetheless, this is not my main activity. My main income comes from being a carrier of cargoes, and unfortunately, in this situation, there is not much to do for the environment.

Four out of the 19 CE practices were not evidenced: P5 – quality and environmental management system integration; P6 – environmental auditing programs such as ISO 14000 certification; P9 – the internal performance evaluation system incorporated into environmental factors; and P10 – the creation of environmental reports for internal evaluation.

This deficiency was found in several small companies studied by Mello et al. (2015). They pointed out that environmental issues are often addressed through non-systematized

![Table showing evidence of CE Practices](image)
practices, which are focused on complying with legislation and waste recycling policies. These findings are consistent with the study of Degenhart et al. (2016), which identified the reactivity or animosity of companies in relation to the disclosure of their environmental information, which is not required by law.

The managers who perceive environmental issues as a business opportunity tend to integrate them into the company’s strategic planning, implement new technologies, institute training programs, as well as establish organizational incentive policies (Dubey et al., 2018; Muduli et al., 2013).

The implementation of practice P1 – commitment of environmental management from senior managers was recorded only among the players who had the greatest number of practices implemented: Entrepreneur A, with seven practices implemented; Farmer 1, with 10 practices evidenced, as well as Alpha Company and Farmer 2, which implemented 12 CE practices, a number equivalent to more than 60 percent of the researched constructs.

On the other hand, the lack of commitment of the top management is related to the absence of knowledge and control over the environmental aspects (Govindan et al., 2014; Oelze, 2017). For instance, during the follow-up to the removal process of the chicken litter, it was observed that the vehicle had oil leaks and emitted excessive black smoke. Additionally, evidence of periodic maintenance could not be verified, and when asked about this, Entrepreneur B was not knowledgeable about the consequences of these sources of pollution for the environment or the importance of maintaining good conditions for the conservation of the vehicle for economic safety reasons.

Most of the players do not have a hierarchical structure that supports middle management, which is why practice P2 – support for environmental management from mid-level managers was verified only in the three companies constituted and classified as small.

Alpha Company incorporates the environmental aspects in its training on health and safety at work (P4). Rural cooperatives act as centers of knowledge diffusion and produce empowerment in ecologically based agriculture (Almeida and Abreu, 2009). According to Farmer 1, the techniques learned improved production and environmental quality: “We usually do the training in the cooperative and then teach the rest of the family and employees. The technician also visits the property, accompanies the project and clarifies the doubts.”

Organic agriculture requires adequate procedures and technologies (Souza et al., 2015). Farmer 2 reported that the change from the traditional to organic farming was guided by the cooperative: “Without the use of pesticides and chemical fertilizers, our products are healthier, the land is more fertile, the cultivation has become cheaper, and we have a relevant market.” These aspects correspond with the study of environmentally friendly practices for agriculture districts in China (Toop et al., 2017).

The fact that practice P3 – cross-functional cooperation for environmental improvements was evidenced in the same players that implemented P4 (special training for workers on environmental issues) corroborates the findings in the literature that the ability of employees to contribute to environmental activities can be increased through training (Alayón et al., 2017).

Environmental labeling is not widely used among the players in the network; therefore, the implementation of practice P7 was evidenced in only two of them. The statements of both converge to emphasize the importance of family and organic agriculture labels for sustainable production. According to Farmer 2:

[...] the consumer can not differentiate the vegetables produced in an organic way from those produced by the conventional system; therefore, this consumer needs some identification to trust that the product is free from pesticides, and the producer also needs to defend his market.

Thus, Moura (2013) pointed out that environmental labeling meets these economic and communication needs, as it differentiates the product from its competitors. Further, Lombardi et al. (2017) found that exposure to information about environmental practices can positively change consumer behavior.
Cleaner production practices constitute a milestone in the transition to a circular business model (Sousa-Zomer et al., 2018). Pollution prevention actions (P8) were evidenced among rural producers, such as the use of biodiesel as fuel for generators. Other pollution control and treatment interventions, known as “end-of-pipe” measures (Glavič and Lukman, 2007), such as systems for the treatment of domestic effluents by septic tanks and bio filters, were verified for Farmer 2; for Alpha Company, containment basins for chemical product deposits were verified. CE practices related to the planning and design phase (P11 to P14) stand out as the most frequently implemented. In order to reduce the consumption of resources and materials (P11), the most commonly performed actions were energy acquisition by contracted demand, the replacement of machine parts, and the use of economical lamps by the Alpha and Gama companies. The rural producers used solar energy, rainwater and irrigation by drip and micro sprinkler techniques.

It was observed that the P12 practice, common to all players in this network, interconnects them in the flow of the reuse, recycling and/or recovery of Alpha Company’s by-products. Moreover, it is aligned with the NSWP, regulated by the provisions of Federal Law No. 12,305/2010, which recommends the final disposal of waste in landfills only when other treatment alternatives are unavailable (Brazil, 2010). The CE does not find consistent support in the Brazilian legal system, because the programs foreseen by the NSWP have not yet been effectively implemented, and there are no official EC indicators, which constitutes a barrier to the EC, as identified by Galvão et al. (2018).

For Gama Company, it was not possible to confirm its declaration regarding the commitment to eliminating or reducing the use of dangerous products (P13). It was observed that the packaging and residues of various chemical products such as medicines for birds and sanitizing products were discarded along with the common waste, and their final destination was the municipal sanitary landfill. The environmental contamination by drugs is associated with potential impacts on human and animal health, for instance, the risk of the development of resistant bacteria and other unknown adverse effects (Eickhoff et al., 2009).

The processes of Alpha Company and Entrepreneur B were the leanest and the most highly waste recyclable, and therefore, the most aligned with practice P14.

The practices aimed at the recovery of investment (P15 and P17) were evidenced only in Farmer 2, who mentioned having sales and exchange relationships facilitated by the cooperative. The other players declared that they work with suitable materials and equipment for their production. As stated by Alpha Company’s manager, “the production needs to match to the incoming material; therefore, we cannot stock either the raw material or the product.” As pointed out by the owner of Beta Company, there is no excess of equipment.

The implementation of practice P16 – sale of scrap and used materials was validated in Alpha Company through the flow of its by-products and was also evidenced for the retailers that sell aluminum and paper waste.

The practices P18 and P19 were evidenced only in Entrepreneur B, which in addition to recycling the waste of Alpha Company uses various materials such as scrap metal, tires, electrical appliances and electronics in the manufacture of decorations and utilities.

The CE concept includes the prevention of toxic materials and waste recycling, protecting the environment from their use as non-toxic elements (MacArthur et al., 2015). The importance of adopting technical criteria for the use of chicken litter as a biofertilizer is stressed in order to avoid environmental degradation (Corrêa and Miele, 2011). The studies have pointed to the persistence of antibiotics and pathogens in chicken litter after composting (Hahn et al., 2012) and the contamination of crops by lead (Machado et al., 2008) and copper (Ribeiro et al., 2007). There was no evidence that Farmers 1 or 2 had any mechanism to monitor the risk of contamination.

Although the players are aware of the relevance of their environmental contributions, the network was formed intuitively and did not receive any institutional support or coordination.
There were fewer observations of practices in the management category, which confirms the tendency pointed out in Giunipero et al. (2012) study for the environmental variable not to be included in strategic business planning.

As pointed out by Abreu and Ceglia (2018), the CE business model requires institutional capacities to be strengthened through market instruments, public and private partnership policies and legislation.

Although it was beyond the scope of this paper, the study of CE practices led to the identification of barriers to its implementation. There is a gap between the expansion of environmental management and the application of a beneficial economy to the environment (Fuks, 2012). Consensus was found among the players interviewed that CE practices compete with other priorities, and for financial reasons, are often overlooked. The same problem was found for the small companies studied in the Baske by Ormazabal et al. (2016). Clients' lack of interest in the environmental aspects regarding the product or service was a recurring justification for the non-implementation of CE practices.

Entrepreneur A recognized that there would have been more opportunities for production and growth if companies did not keep their processes stagnant and were open to integration: “Most industries do not have any interest in unconventional materials and processes.” The resistance to change and the shortsightedness identified among the stakeholders were considered to be the main causes of failures in the agricultural CE in Finland (Kuokkanen et al., 2016).

Gama Company believes that CE practices would be more easily implemented if organizations shared the knowledge they gained: “Even companies operating in different markets behave as competitors and keep their experiences confidential. As there is not any possibility of exchange, adherence to CE practices requires time and investment in training or consulting, which makes it an unfeasible change.” Common concerns such as climate change, resource scarcity and other environmental issues require deep discussions and shared experiences (Korolev et al., 2018).

Other points cited by the interviewees were the lack of tax incentives to reuse materials and increase the shelf life of products, as well as the price of some recycled raw materials, which are generally uncompetitive or even more costly than virgin raw materials. The use of incentive taxes has been highly recognized by authors as an instrument to foster the implementation of environmental policies aimed at achieving several objectives, from energy saving (Yi, 2014) to innovation (Liao, 2018).

The barriers identified by the network players are consistent with the literature; however, there are some classification differences, such as those found in the study of CE barriers by Galvão et al. (2018). A framework was developed based on the nature of the CE practices to be implemented in order to address the barriers frequently encountered, and actions were suggested to overcome the challenges, as shown in Table III.

The organizations must overcome internal obstacles to establish a cooperative network for the CE. The CE proposes a new configuration of materiality for which profound transformations are needed, not only in the productive processes but also in their foundations regarding the essential and non-essential demands that shape consumer patterns (Lieder and Rashid, 2016; Sauvé et al., 2016).

Relevant measures to improve internal environmental management have been suggested, such as the continuous evaluation of environmental performance metrics, risk management, the alignment of policy, mission, vision and values with corporate environmental responsibility, the creation of a common platform of knowledge and information, investments in the ongoing training of employees and the dissemination of knowledge to stakeholders (Geng et al., 2016; Mudgal et al., 2010).

Furthermore, institutionalized models such as the creation of funds and credit lines for the execution of CE projects and the development of new markets for alternative materials,
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<tr>
<th>Barriers identified</th>
<th>Suggested actions to overcome challenges</th>
<th>Authors</th>
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<tr>
<td><strong>Internal environmental management</strong></td>
<td>Fostering collaborative practices</td>
<td>MacArthur et al. (2015), Geng et al. (2016), Hopkinson et al. (2018), Urbinati et al. (2017)</td>
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<td>Creation of technical training programs and dissemination of knowledge</td>
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<td><strong>Contextual</strong></td>
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<td>Risk aversion; Lack of support and motivation</td>
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<td><strong>Structural</strong></td>
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<td>Competition and uncertainty in the market; Lack of commitment of the consumer and other network players</td>
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<td>Hierarchy and bureaucracy inhibit innovation</td>
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<td>Lack of learning mechanisms</td>
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<td>Resistance to innovation</td>
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<td>Fiscal incentive policies for the reuse of materials</td>
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<td>Contextual</td>
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<td>Investment recovery</td>
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<td>Cultural</td>
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<td>Creation of eco-industrial parks</td>
<td>Gregson, Crang, Fuller, and Holmes (2015)</td>
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<td>Contextual</td>
<td>Protected technologies; Lack of control and waste of materials and inputs</td>
<td>Redefinition of consumption targets and incentive to the leasing system</td>
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**Source:** Research data
as well as the reformulation of waste collection and disposal rates, tend to encourage
investment between companies and private partnerships (Ribeiro and Kruglianskas, 2014)
as pointed out by Fischer and Pascucci (2017) in their study addressing institutional
incentives for the transition to a CE.

In order for CE results to exceed waste exchange, a focus on product design and
development is recommended. The use of integrated tools such as LCA, mass balance
and dematerialization can propel organizations to a productive stage that challenges the
traditional models of production, and consequently, of consumption (Preston, 2012;
Sauvé et al., 2016).

There should be no clash between economics and ecology in the constantly changing
environment in which firms are embedded (Porter and Vander Linde, 1995). There are
factors that may contribute to the recovery of investments; we highlight the systematization
and diffusion of information aimed at increasing the bargaining power of companies, for
instance, databases with projections of numbers and types of waste, technology sharing and
collaborative product development (Gregson et al., 2015).

The CE is based mainly on the Chinese and EU experiences. They have relevant
differences from the Brazilian political and economic scenario, which lacks the legal
framework to achieve the appropriate development of the CE. Another hurdle is related to
the lack of economic instruments for and the participation of society in the rational use of
natural resources. Those particularities require that caution be used in finding direct
equivalence between efforts and policies (Mathews and Tan, 2016).

Therefore, the network of players studied has particular characteristics and faces several
restrictions that may affect the timely implementation of CE practices, such as the decrease
in the production of pallets due to the deceleration of the Brazilian economy since 2015
as a result of the economic crisis (Rossi and Mello, 2017), as well as the exhaustion of
organic production due to its high price in relation to conventional agricultural products
(Silva et al., 2005).

The case study format was the second most used procedure among 500 published papers
about the CE indexed at the Web of Science and Scopus databases up to April 2017.
According to Merli et al. (2017), these studies aimed at applying the CE in specific
contexts or comparing its geographical differences. Further, as pointed out by Petit-Boix
and Leipold (2018), cities’ initiatives to implement the CE are commonly reported in
non-academic journals, and because of the absence of peer-reviews, these data sources are
frequently avoided.

5. Final considerations
The CE is a topic that has evolved rapidly as a possibility to reconcile environmental
preservation and economic growth. The joint efforts of academia, NGOs, public decision
makers and stakeholders should be focused on the implementation of strategies and
overcoming challenges.

The bibliometric study of the CE in the Web of Science, Scopus and Google Scholar data
sources developed by Türkeli et al. (2018) noted that like India and some European
countries, Brazil has produced many citations, but few effective contributions to the CE
literature. Along with studies such as the one developed by Oliveira et al. (2018), this
research aimed to document the application of CE practices in a local network and bring this
current paradigm shift into the Brazilian context.

Despite the fact that this paper focused on the execution of CE practices, the findings
allowed the mapping of research routes to address the main barriers and to suggest actions
to overcome the challenges, i.e. the restructuring of business relations, the elaboration of
public policies and the development of infrastructures that facilitate the materiality flows
and the market.
In addition to this theoretical contribution, the study provides practical insights for managers and entrepreneurs with the purpose of implementing the CE business model, as well as highlights the need for public policies that promote cross-sectoral cooperation in accordance with the NSWP’s objectives.

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**Corresponding author**
Flavia Cristina Silva can be contacted at: flacrisil@yahoo.com.br

**Associate Editor**: Felipe Lara

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Elements that influence knowledge sharing in the university-industry-government collaboration

Case studies in Brazil

Igor Junqueira de Castro, Marcelo Seido Nagano and Suzana Xavier Ribeiro

Engenharia de Produção, Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos, Brazil

Abstract

Purpose – The purpose of this paper is to determine the factors for an academic research project in electrical engineering to become relevant.

Design/methodology/approach – As a conceptual basis, a few theories of entrepreneurial university and triple helix were correlated, seeking to determine the main critical factors and the successful criteria of an academic research project. The research was conducted through four cases of electric engineering that succeed in generating social and economic impact.

Findings – When analyzing the available bibliography, it is clear that the connection among the companies, the market and the research that happens at the university is very important. Not only that, but also, according to the results, this is the key to generating revenue and impact on society. In addition, operational policies and competent leaders promoting this impact inside the universities are extremely important.

Originality/value – The topic was selected because of the reduced number of articles related to the identification and analyses of the main aspects that make an academic research project relevant to the society. Furthermore, the paper is significant because it analyzes the main factors that help develop a better society and country through academic research.

Keywords Knowledge sharing, Innovation, Entrepreneurial university, Entrepreneurship, Electrical engineering

Paper type Research paper

1. Introduction

It has become clear since the second half of the twentieth century that society is increasingly more connected to knowledge development and its practical applications in new technologies. This way, the university assumes a central role, once it stands for three functions: education, research and extension. The first pillar, in a more practical way, looks to develop citizens to generate new knowledge, developing its nation; the second pillar focuses on knowledge generation itself, by doing academic research; and the last and third pillar approaches the development of extension activities, searching for a closer connection among university, external stakeholders, society and private companies or organizations.

Technology, as a product and producer of the innovation process, reflects the degree of aggregated knowledge, the set of skills and the ability of learning an organization has in a
certain moment. Innovation can be seen as a flow, as it is a transformational process that results from accumulated skills, knowledge and technology. Innovation and technology are gathered through unspoken and by explicit expertise, which result from collaborative learning, that were already created (Dudziak, 2007).

In this context, the Brazilian scenario is still incipient accounting for its social character of generating development through science, technology and innovation (STI). National vision is that application in science, mainly in universities, happens through education and not necessarily innovation or knowledge creation. This method of conducting science has been contested by academic research studies that proof the value of a university able to generate knowledge and actually apply it in society (Brito Cruz and Pacheco, 2004).

However, even with this indifference, it is possible to observe the importance of knowledge development in Brazil. According to data of the Organization for Economic Co-operation and Development (OECD, 2012), investment in research and development (R&D) in the country is close to great centers of research, such as UK, Canada and ahead of others, such as Italy, when comparing the share of GDP invested in R&D.

Nevertheless, more than the creation of knowledge and innovation through R&D, the Modern Age reiterates the importance of a “Third Mission”: the economic and social appreciation of knowledge produced by researchers in the universities. The definition of this mission imposes the need for strategies, structures and mechanisms to facilitate and identify knowledge transference to the private sector in many ways: licensed patents, academic spin-offs, startups and others. Therefore, universities would also need to develop a culture more oriented to entrepreneurship, with researchers engaged into this culture (Etzkowitz and Leydesdorff, 1995). Such model also spans the importance of the relationship among three stakeholders: government, universities and companies (Fayolle and Redford, 2014).

Based on this, the need for more entrepreneurial universities becomes clear. Those organizations should alter their strategies, structures, practices and culture to help students and community members to act in a more entrepreneurial way. But, in general, universities are bureaucratic institutions and, as a consequence, present low ability to adapt itself and to adopt new behaviors (Fayolle and Redford, 2014).

2. Bibliographic review
In this topic, a literature revision addressing the main topics important for this paper is presented: entrepreneurial university and collaboration among universities, companies and government. The main dimensions and topics that influence those two topics are also approached in this section.

2.1 Entrepreneurial university
Etzkowitz (2003) outlined the concept of entrepreneurial universities to describe a series of changes that reflect the role of universities in promoting academic research knowledge transference in a more direct and active way. However, technology transference is something challenging, once private companies and universities have, in general, distinct missions and mutual suspicion.

Although, not only Etzkowitz approached the concept of entrepreneurial universities, but also different scholars, such as Chrisman et al. (1995), Clark (1998a, b) and many others. Even though there is no unique concept about what is an entrepreneurial university, there is a consensus that it is related to knowledge transference with the purpose of causing economic and social development. In other words, every research project and knowledge produced in a lab should aim, somehow, to benefit society, by its economic and social results.

Not only academic researchers, but also OECD approached the theme, synthesizing every concept and knowledge developed by research projects about the topic and created a framework defining what is an entrepreneurial university. The frame describes seven
functions: “Leadership and governance,” “Organizational capability, people and incentives,” “Development of entrepreneurship in the education,” “Paths to entrepreneurs,” “University company,” “External relations for knowledge sharing,” “Universities while international institutions” and “Measurement of university impact.”

2.2 Critical factors in an entrepreneurial university
Many factors influence the success of an entrepreneurial university strategy implementation. Blok et al. (2014) identified, in their study, five macro factors with huge influence: “Strategy,” “Resources,” “Infrastructure,” “Reach” and “Development.” Each of those factors is composed by activities and tangible actions, so it is possible to reach a higher level of granularity to design the better strategy to become an entrepreneurial university.

Strategy. The macro factor “Strategy” involves how universities introduce an entrepreneurial education program in their strategy (Niras, 2009). The activities related to this factor are: mission and strategic objective of universities, and operational politics that are unfolded of such objectives in order to improve the strategic program of the entrepreneurial university. The mission and strategy are important to demonstrate an agility to adapt to rapid changes that should present in that kind of organization (Sporn, 2001). Those strategic objectives, previously described, need to be present in every and each level of leadership of the organization and present in the politics of every department (Potter, 2008).

According to Sotirakou (2004), not only the structure of the governance, but also the style of the leadership in the universities should create a scenario where entrepreneurship programs might prosper. It implies programs should be supported by the university employees, and by directors.

Resources. Another crucial factor for the development of an entrepreneurial program is the availability of finance it (Niras, 2009). Specific activities regard the amount of resources, the type of resources available and own income generation to the university, through patents, consulting or even product selling. Many researchers mentioned the importance of finance to develop and execute activities related to entrepreneurship, stating that it is impossible to implement those practices without dedicated funds.

Not only the size of the budget matters, it is also important to understand the availability of resources during a constant period of time, maintaining programs’ sustainability (Potter, 2008). Sporn (2001) alerts about the dependence of resources from the government, as it reduces the capacity to adapt to changes in the university environment. Diversification of revenue streams diminishes considerably universities vulnerability (Clark 1998a, b) and increases programs’ sustainability (Potter, 2008).

Infrastructure. The third factor influencing on building an entrepreneurial university is the infrastructure offered by the institution, which not only structures to support the education (Niras, 2009), but also ensures specific actions to develop and improve: structures such as incubators or entrepreneurial centers; and structures for research, and study of entrepreneurship. Garavan and O’Cinneide (1994) showed the importance of a space to conduct an entrepreneurship education, while Etzkowitz (2003) also recognized the importance of such structures (Siegel and Phan, 2005). Glas and Menzies (1998), in addition, showed that entrepreneurial centers help to develop an entrepreneurial mindset, and improve the transfer of knowledge between university and society.

Just as the education and the research about entrepreneurship would be multidisciplinary by nature (Coduras Martinez et al., 2010), it would need to have structures and programs to encourage multidisciplinary contacts. These programs should not be only different courses offered by the university (Potter, 2008); instead, these should act as incentive to reduce institutional barriers and to build bridges between ideas and knowledge among students, professors, researchers and other community members (Wiese and Sherman, 2011).
Reach. The factor “Reach” is essential to understand the mutual influence among the program of entrepreneurial university, local environment, community and business around the institution. Connections with local corporate environment grant to students, professors and researchers the opportunity to have practical entrepreneurial experience, and develop a more entrepreneurial mindset (Niras, 2009). Specific activities related to this factor are: involvement with external stakeholders, and alumni programs. Pittaway and Cope (2007) presented the importance of external stakeholders such as entrepreneurs, employees, governmental and industry representatives, and possible clients to facilitate the development of entrepreneurial skills.

The value added by these connections relies on the possibility to promote technical support related to business administration and on the development of skills by the university community (Hynes and Richardson, 2007). University alumni can be useful in the development of entrepreneurial activities (Niras, 2009), offering, for instance, classes as guests or even offering internships (Matlay, 2011). Besides the stakeholders already presented before, it is also important to be involved and engaged with local community, seeking knowledge transfer and society development (Etzkowitz, 2003).

Development. The factor “Development” is related to the continuous improvement of programs and activities related to entrepreneurship, based on monitoring and changing to meet stakeholders’ expectations. With an ongoing improvement of those programs it is possible to meet the desire of everyone involved (Niras, 2009). The activities connected to this factor are: measurement of frequent programs with internal and external stakeholders, and improvement toward needs identified by the measurement previously done. Using this method of continuous improvement, the university can achieve a better entrepreneurial environment.

2.3 Success criteria of an entrepreneurial university
Blok et al. (2014) combined the results of the research of Niras (2009) with the purpose to identify which are the best performance indicators and the dimensions connected to entrepreneurial programs.

Those performance indicators are divided in three macro groups of entrepreneurial university impact measurement: “Education,” “Knowledge Transference, and “Practical Study” (Blok et al., 2014).

Education: representation of students enrolled in entrepreneurship courses and classes. This indicator measures the extension of entrepreneurial mindset and how it is widespread in the university as a whole.

Knowledge transference: number of patents, external financing and studies revised by others researchers. This indicator measures how the knowledge transference actually happens in the entrepreneurial university and what are the consequences of this knowledge previously developed.

Practical study: representation of students enrolled in extracurricular activities. This indicator measures whether the entrepreneurial university is being able to create mechanisms of practical education and not only theoretical classes.

3. Research method
The research method is to understand the main factors to develop an academic project that brings economic and social development. In other words, a project that fits in the concept of entrepreneurial university was based in four electrical engineering case studies.

With the objective of doing so, a research instrument was used to measure which factors influence the development of each project. The factors researched were previously presented in the bibliographic review and proposed by Blok et al. (2014): “Strategy,” “Resources,” “Infrastructure,” “Reach” and “Development.”
After applying the research instrument to determine the main critical factors for each project, the results were weighted according to the performance indicators proposed by Blok et al. (2014). The group of indicators used was “knowledge transference,” as the goal is to measure only the performance of a specific academic project and not necessarily of the university as a whole. Therefore, to calculate the performance indicator of each project \( p_i \), the following factors were considered: number of patents (NP), number of external financing (FE) and number of peers’ review (RC). Those factors were weighted by the formula below, once peers’ review is a secondary impact, supporting other’s research and not directly the society:

\[
p_i = \frac{2 \times NP + 2 \times FE + RC}{5}
\]

After that, the ponderation of each factor is made using the formula below. The importance of each factor for each academic project \( f_i \) is weighted by that project’s results \( p_i \), according to the performance indicators:

\[
\sum_{i=1}^{n} \left( f_i \times p_i / (p_i) \right)
\]

4. Case studies

The four cases studied are academic projects in electrical engineering and were developed in different educational institutions.

4.1 Measurement of suitability of sunglasses to the norm of ultraviolet and luminous transmittance

The research project developed at the São Carlos School of Engineering expected to build a simple equipment for measuring ultraviolet and luminous transmittance of sunglasses. The purpose was to get a device in which a regular citizen could easily and intuitively measure his own glasses and get the answer whether he should use it or not, according to the ultraviolet transmittance. Until then the measurement of the ultraviolet transmittance was carried out from the spectrophotometry, which needed specialized professionals for measurement and presented high purchase and maintenance cost.

The company was opened with the support of the Small Business Innovation Research Program (PIPE) of the São Paulo Research Promotion Agency, FAPESP (São Paulo Research Foundation). The first two products of the company were the ultraviolet transmittance meter previously developed in the laboratory, and the display used for the construction of such devices. In the development of the company, the entrepreneurs were incubated for some time in ParqTec, a local incubator, and received three financing scholarships by the PIPE of FAPESP (2010) and got to have a registered patent.

Entrepreneurs and researchers attribute much of its success to the great leaders they have had in their journeys. In addition, the will and tenacity to undertake was also pointed out as very important characteristics.

4.2 Diagnosis of dermatological diseases via optical techniques

A researcher developed his doctoral thesis in the Department of Electrical Engineering of the School of Engineering of São Carlos and his goal was to develop a portable device that, through the use of light patterns, could detect changes in the epithelium of patients. The equipment measured the change of chemical components after the application of aminolevulinic acid and application of light.

The researcher realized this technique also possessed the ability to perform dental diagnoses, since when applied to the teeth, the system also had the capacity to find caries.
With the products developed, in 2011 the team opened a company. Their aim was to market such innovative diagnostic techniques. In the development of the project, the company was incubated in the ParqTec and received support from PIPE, through three different financing. Currently, the company focuses more on the commercialization of test equipment for medical equipment due to the strong Brazilian regulation on medical equipment.

Like the previous case, the entrepreneur attributes a significant value to the leaders who contributed to the project. The encouragement given by his advisors was essential to think outside of common sense and bring the solution to the market.

4.3 New method of locomotion for people with physical disabilities

A graduate in Biomedical Engineering from the National Institute of Telecommunications (INATEL), during his course approached the development of technologies in the area of electrical engineering from projects of scientific initiation. One of the main projects conducted by the student was a mobile device capable of allowing the physically disabled in an upright position and allowing them to move. Such equipment was denominated Dynamic Orthostatic Chair. The Orthostatic Dynamic Chair seeks to overcome the difficulties faced by people with modular injury, helping in the erect locomotion. The user, by standing up, can perform habitual activities, within the limits imposed by the disability. The equipment moves from motion sensors attached to the user’s head or from remote control.

The researcher also developed several other projects that seek to impact society, such as a hydrocephalus diagnostic method, which is currently being tested and used by the Medical School of the University of São Paulo.

The entrepreneur, unlike the other researched in this paper, studied and developed all his research in a private education institution and stated that the encouragement of entrepreneurship and of the development of solutions for social and economic impact was very natural, different from the cases of public educational institutions.

4.4 New method of virtual reality execution using clusters

In his master’s thesis, a researcher focused on developing a method of execution of virtual reality from clusters that allowed a greater speed for the method. The main innovation was a new algorithm to increase the speed of the tracing technique, which until then was very slow, despite the very superior quality. Such technique is widely used in films and special effects.

After developing such algorithm, the researcher had as objective to take what he developed in laboratory to the market. Initially a PIPE project was opened by FAPESP to fund and develop the company. While the project was not approved, the entrepreneur did specific projects in the area to generate his own income.

Once the funding was approved by FAPESP, the company was opened and began to develop projects in the area of virtual reality and image processing. Today, the company develops projects for several clients and has six specific products in the area.

In the opinion of the entrepreneur in this case, the main success factor was his resilience and willingness, since he obtained very little support to take his project to the market and open his own company. He testified that in many situations he was widely criticized for not wanting to pursue a purely academic career.

5. Results

The results evaluated in the case studies were based on interviews conducted using the “Data collection instrument.” Those results were divided into two sections, “Quantitative results” and “Qualitative results.”
5.1 Quantitative results

The quantitative results were based on direct questions based on bibliographical research. The five factors analyzed were strategy, resources, infrastructure, reach and development.

Of the five macro factors analyzed, two stood out with an average above four points. “Resources” stood out, with 4.47 points, as the main factor that influences a research project to generate impact in society. This factor accounts which financial resources are available and how they are allocated. These financial resources do not necessarily come from university programs and research entities, but from own revenue generation.

The second macro factor that influences the impact of research projects is “Reach.” This includes how the research project, the laboratory and the university relate to external stakeholders. In other words, it assesses how the reach and relationship with clients, companies, society, alumni and others is given (Figure 1).

As presented in the research method, the macro factor of “Strategy” consists of three factors. The highlighted factor, with 4.52 points, is how the strategic objectives of the organization are presented in the leadership of the university. That is, in what concerns the impact on society of a research project, it is essential that there are figures of leaderships that influence and direct the researchers. Such leadership figures can be research coordinators, teachers, mentors or even departmental leaders. It can be observed that the mission and strategy of the university are not presented as essential factors (Figure 2).

The main factor related to “Resources” would be the own generation of income by the laboratory or the research project. This is due to the fact that for a project to have an impact on society, it must generate value and, thus, be able to generate its own resources.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Resources</th>
<th>Infrastructure</th>
<th>Reach</th>
<th>Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.97</td>
<td>4.47</td>
<td>3.62</td>
<td>4.21</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Figure 1. Result by macro factor

<table>
<thead>
<tr>
<th>Mission and strategic objective</th>
<th>Operational policies unfolded from strategic objectives</th>
<th>Presence of strategic objectives in every leadership level and in department’s policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.12</td>
<td>4.27</td>
<td>4.52</td>
</tr>
</tbody>
</table>

Figure 2. Result by factor related to strategy

Source: Prepared by the author
The government, the university and research promotion agencies will not be able to maintain the research project in the long term if there is no financial sustainability. In addition, it can be noted the amount of resources allocated by the university is not a relevant factor, with only 3.85 points, as it depends very much on how resources are allocated. That is, it is not enough to invest a huge amount of financial resources if it is not applied in a proper and useful way for the researchers and the research project (Figure 3).

Meanwhile, the macro factor “Infrastructure” highlights how structures for research and study of entrepreneurship affect projects. The relevance of this factor is due to the fact that the electrical engineering course is extremely technical and theoretical, so students and teachers do not have as much knowledge of the step by step to take to market, besides having few incentives to do so. Therefore, structures such as subjects, research and entrepreneurship clubs appear to be extremely relevant to the development of research that impacts society (Figure 4).

The macro factor of “Reach” would be the second most important to provide the practical application of the research project. This is mainly due to the involvement of the university and the research project with external stakeholders. Therefore, the relationship with the market, other companies, clients and investors is very important (Figure 5).

“Development” would be the macro factor that refers to the continuous improvement of research support programs by the university by the development agencies. It is noticed that in the same way, the measurement and the implementation of improvements appear as relevant (Figure 6).
In order to understand the factors that most influence the impact on society of a research project, five items stood out. For the project to succeed, it should be able to have its own income generation, resources should be allocated in the right way, with a good involvement with the market, other companies and with customers. It is also necessary that such a scenario presents a background with university leaderships prepared to encourage and assists the researchers and students to undertake, in addition to clear operational policies from the Universities that allow such incentives (Figure 7).

5.2 Qualitative results

Of the four cases studied, three used the PIPE program of FAPESP to create their companies from research projects, highlighting the importance of structures and mechanisms. Thus, having promotion research agencies and the university concerned about society impact is extremely important to ensure that research conducted in laboratories generates social and economic development, as long as such concern is accompanied by clear operational mechanisms.

Development programs must also adapt to the real needs of researchers. All the cases studied emphasized the importance of programs that approach researchers and students and do not have large bureaucracies. PIPE, for example, is a program little known within the university and requires high level of bureaucracy.

Another factor pointed out as important by the researchers studied are the leaders who influenced their paths. They all pointed out a few people who were essential to the success of
their projects, usually the advisor or leaders of the research laboratory. Such leadership has the function of facilitating the research project path through market contacts or previous step-by-step experience.

Parallel to the incentive of laboratory leaders, incubator structures of companies also appear in a relevant way. In general, such structures are places in which entrepreneurs connect and form a network to support their companies’ growth. Additionally, these structures are spaces more connected to the market and that usually help in a route of going to the market.

Finally, the most important point indicated by the researchers was their own will to undertake. In general, they were people with different life experiences and who at some point had incentives to go in that entrepreneurial direction. All pointed out that this type of experience does not happen in the traditional classroom, since the general culture that permeates these means is extremely academic.

6. Final considerations
This paper presented as main objective the understanding of what are the critical factors that lead an academic research project to achieve significant social and economic impacts. The importance of this theme comes from the significant Brazilian investment in R&D, about 1.3 percent of GDP in 2016. From a precise definition of such factors, it is possible to define the best way to allocate such investment, seeking the greater technological and economic return to the country in a practical way.

To reach this objective, the work focused on the concept of Entrepreneurial Universities in the bibliographic review. This concept accurately predicts which are the main factors that guarantee an efficient transfer of knowledge between the academic environment and the private sector, generating social and economic impact. The concept predicts that five key factors are key to success: strategy, resources, infrastructure, reach and development. They influence how the university prioritizes the incentive to entrepreneurship and helps to identify what needs to be done in order to the university achieve the title of “entrepreneurial university.”

With such factors defined, there was also a search for the understanding of how the Brazilian situation is in this sense. It is noticed that in general the academic knowledge developed in the country comes from universities and public research agencies, which makes it difficult to transfer knowledge to private sector in many cases. Therefore, in this context, it is extremely important to create mechanisms to ensure that the university does not become an isolated environment. As an important step in the way of creating such mechanisms, a new framework for supporting technology and innovation was approved in 2018. The new science and technology decree deals mainly with stimuli for the scientific and technological development of the country. Among many other advances for the country’s technological development, the mechanism allows public institutions to give space for business use, focusing on the construction of environments that promote innovation.

The paper also sought to focus on the concept of what is a successful research project within the context of university entrepreneurs. That is, what are the objectives and simple measurement criteria that prove its success, in terms of social and economic impact, of an electrical engineering thesis developed in the laboratory. From the bibliographic review, it was possible to identify three major milestones that should highlight this: number of patents developed, number of external financing and number of knowledge review by colleagues.

After such definitions, the research methodology was defined. It intended to understand what are the main factors, in the opinion of successful cases, that influence a successful research project. For this purpose, four cases of success were defined, which answered the interview guided by the research instrument developed. Based on the answers of each question, a weighting factor was applied according to the success obtained by such a project according to previously defined success criteria. In this way, it was possible to understand
quantitatively the main factors for the social and economic success of such projects. In addition, the interview also sought to understand qualitative success factors.

In the quantitative results, the importance of own generation of income from the research project is perceptible and to succeed in this criteria, the company also needs to be able to have a good relationship and contact with external stakeholders, such as customers and other companies. In addition to understanding the market and being able to generate its own revenue, a successful project also depends on good operational policies on the part of the university and of the development agencies (CNPq, FAPESP and others), since they are extremely relevant to put in practice the desire of the university to become an entrepreneurial one. Finally, another factor of extreme importance is the presence of strong leaders who influence and encourage students and researchers to have contact with the market and develop solutions that can be applied in a context larger than the academic environment.

It is interesting to note that although important, both allocated resources and university mission, appeared as secondary factors. According to the researchers, the main driver for success is the organization’s culture and the factors previously cited. Therefore, it can be inferred that simply increasing investment in innovation in Brazil should not be enough for an efficient technological development, since there are many other factors and mechanisms that need to be rethought and addressed previously.

References


**Corresponding author**
Marcelo Seido Nagano can be contacted at: drnagano@usp.br

**Associate Editor**: Adriana Marotti de Mello

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Intention to live in a smart city based on its characteristics in the perception by the young public

Luis Hernan Contreras Pinochet and Giulie Furtani Romani
Department of Business Administration, Universidade Federal de São Paulo, Osasco, Brazil

Cesar Alexandre de Souza
Department of Business Administration, Faculdade de Administração, Economia e Contabilidade da Universidade de São Paulo, São Paulo, Brazil, and

Guillermo Rodríguez-Abitia
Dirección General de Cómputo y de Tecnologías de Información y Comunicación, Universidad Nacional Autónoma de México, Mexico City, Mexico

Abstract

Purpose – The purpose of this paper is to identify the intention of living in a smart city as from its characteristics in the individual perception by the young public based on the proposal of an expanded model.

Design/methodology/approach – The empirical research carried out herein was based on a survey, consisting of a sample of 380 valid questionnaires. Data analysis was carried out through multivariate quantitative approach using structural equation modeling, with estimation by partial least square.

Findings – In the model, it was possible to adapt all the characteristics of smart cities. The “environment” characteristic was the one that presented the greatest relationship in contributing to efficiencies that allow the migration of citizens and in reducing the environmental impact in the cities’ quality, and the “economy” characteristic was the one that presented the lowest relationship opening the opportunity that this concept can be more widespread within the economic agents and individuals for the society.

Originality/value – Finally, it is argued that efficiency in all characteristics will depend on the engagement of citizens in the innovation processes of public living in general. The smart city is distinguished from other typologies due to its success in the field of innovation, essentially depending on the collaborative process that is developed in environments that encourage discovery and idea generation.

Keywords Smart city, Perceived usefulness, Intention of living, Young public

Paper type Research paper

1. Introduction

Having in mind the increase of population migrating to urban areas, a major concern has been that it could overload the services offered in cities and consequently reduce the effectiveness of their operations as well as contributing to many other existing problems, such as pollution and the resources’ expenditure, which could be aggravated. This has led to the need of finding a way of balancing the living conditions with the population growth.

Based on this, it was then created in the 1990s the concept of smart city, which is based on the principle that there should be an integration among the systems related to services that help living in the urban environment, connecting human and technological capital and seeking ways of improving the relationship between city and population.
A more complete definition is that a smart city is a place where information and communication technology (ICT) is combined with infrastructure, architecture, common objects and our government bodies to deal with social, economic and environmental problems (Townsend, 2014). This concept seeks to solve public problems through solutions coming from technology, supported by municipal partnerships with several stakeholders (European Parliament, 2014). Such technology provides an information and communication basis that allows smart devices to connect to a smart infrastructure, thus, improving the quality of living and the productivity in cities (Algaze et al., 2016).

However, as it is a new concept, it still presents only a few analyses regarding the size of its content and scope, with certain aspects to be further deepened and many issues to be raised, especially in the Brazilian academia. Therefore, studies on smart cities contribute to the national and global scope, as a result of possessing socioeconomic impact and functional applicability, as well as being made up of technological measures, directly changing the living standards of the population (Cunha et al., 2016).

This study addresses a still not sufficiently explored field: the field of analytical models on smart cities. It is based mainly on the research carried out by Giffinger et al. (2007), presenting the six-characteristics model, and the model approached by Khatoun and Zeadally (2016), developed in order to expand knowledge on this subject. Therefore, the objective of this study is to identify the intention of living in a smart city as from its characteristics in the individual perception of the young public based on the proposal of an expanded model. The criterion for selecting the audience was due to the representative role that young people play in society, in the process of building more sustainable and resilient urban cities and rural areas, since they are immersed in new ICTs and regularly engage in discussions to find solutions that allow communities to adapt and grow, even when facing adversity.

The paper was structured as follows: it begins with the introduction, followed by a theoretical review to provide support for building a theoretical model, and generating the hypotheses to be tested in the empirical stage of the study. Then the methodology used for the quantitative phase of this research is presented. Finally, the results are introduced and discussed, and the conclusions drawn are presented.

2. Theoretical reference and model construction
This section deepens the concepts that have been used as support and scientific basis during this study, addressing, at first, a general overview on (2.1) smart cities, technology and society; (2.2) characteristics of smart cities; and (2.3) perceived usefulness and the intention to live in a smart city. These sections provide the description of the model that was used in this research methodology.

2.1 Smart cities, technology and society
Smart cities are defined in different ways by international authors who discuss the subject; however, it is possible to realize that everyone has the idea that the development of smart cities aims to seek the solution of problems and meet the needs of society, which is inserted in the current context of constant technology and innovation. Thus, it is noticed that citizens are a key part in the smart city development (Coelho et al., 2016), as they are the creators and users of services and technologies, providing ideas and feedback about the city.

There are several technologies found in smart cities, including Big Data, Cloud Computing and Internet of Things. However, it should be emphasized that being “technological” is not a synonymous of being “smart.” For example, a garbage collector that shows how loaded it is will not be “smart,” unless it has an interconnected system linked to the city’s cleanup center. Only when there is a “dialogue” between the technologies, one observes the emergence of the smart element. Similarly, there is an emphasis for non-linear calculations, in the search for predictive understanding of small elements in the major consequences of a phenomenon. At this point, the
advancements of artificial intelligence, machine learning and deep learning can be employed, for example, to support the prediction of environmental disasters within a shorter period.

In short, a smart city is based on the use of ICTs in connection with human capital to solve urban problems, and improve processes within the city, seeking to achieve an improved quality of living for its citizens, and achieving sustainable economic development and resource management. Thus, being a theory focused on society and on improving the citizens relationships with the city, the concept of smart city has a clearly high relevance, mainly in the social aspect, being longed for as an ideal city model and the objective for the future of the world urban management.

Moreover, since urbanization has been growing exponentially over the years, it is estimated that by 2050, over 70 percent of the world population will be living in urban areas (United Nations, Department of Economic and Social Affairs, Population Division, 2015). Therefore, the difficulty to organize and keep track of flows (for instance, people, data) of the city becomes increasingly evident. In this scenario, broad benefits arise in the political and government sphere, given a better management of the information produced by the population and, consequently, a better control over the situation in the city, thus, enabling the possibility to solving problems and increasing the efficiency of the operational systems (for instance, security), in addition to reducing management costs.

The concept of smart city is not yet consolidated, so when analyzing the understanding of several authors about the components inherent to a smart city, it can be seen that there is a lack of consensus. For many authors, the focus of a smart city is on ICTs progress; however, different areas of knowledge have been proposing definitions that discuss aspects other than ICTs.

2.2 Characteristics of smart cities

First, it is important to define what smart means to understand what makes a city be considered as such. When the term is mentioned, the immediate reaction is to think of new technologies related to digital devices that are revolutionizing the world (e.g. smartphones, tablets, smartwatch, among others), which are understood as data systems and apps connected to the internet, which allows performing a variety of activities with greater mobility and usability. Such characteristics are the ones embedded in the technology of the smart city concept, thus, with a different direction: instead of being aimed at a consumer, they are aimed at a citizen and these aspects that have a direct impact on such a citizen, as specific characteristics of a smart city (Figure 1), in order to increase their satisfaction and value of living.

Aiming at developing a model that can give a less abstract definition for smart city, one can find some points that converge. The literature most often related to smart cities grouped into six categories or characteristics (mobility, economy, governance, living, people and the environment) according to the model originally proposed by Giffinger et al. (2007). From the available literature on these subjects and based on this theoretical construction, descriptions were made for each of these components.


**Figure 1.** Diagram of smart city

Intention to live in a smart city
Economy. The objective is to create an environment that fosters the growth of the company, encouraging and recognizing the importance of the knowledge-based economy, and promoting creativity and technology development in industries. Through public–private partnerships and international connections between economies, and exchanges in research and technology, the smart city aims at improving productivity and increasing opportunities for citizens, positively influencing the unemployment rate reduction (Strapazzon, 2009; Angelidou, 2015).

Similarly, a smart economy seeks to generate an innovative capacity in an environment of competitiveness and entrepreneurship incentives, presenting as an important issue the flexibility, not only in labor relations, but also in every situation, as well as the interconnectivity, made possible by using ICT tools (Anttiroiko et al., 2013; Zygiaris, 2013).

In the smart city, a shared economy prevails over a purchase economy (Šiurytė and Davidavičienė, 2016) and, in fact, the exponential growth of this phenomenon can be observed in several parts of the world. Therefore, the more people tend to share rather than buy, the less overburdened the city is, making it possible for its systems to be more efficient. This includes also the concepts of e-business, e-commerce and e-government, leveraged by the broad technological basis of the city.

People. According to Giffinger et al. (2007), a smart city cannot exist without a smart population. Citizens are the key part for this knowledge-based urban development, because people not only receive information, but they are also the driving force for its creation. Thus, it is important for cities to focus on increasing the competencies and qualification of the population, emphasizing the need for a better education, social infrastructure and promoting creativity. This is paramount to create a well-trained workforce that is capable of not only having a better perception of the geographic area where they live, but also proposing creative and innovative solutions for their cities (Barrionuevo et al., 2012).

Besides the population level of education and qualification, it is necessary that citizens are active and capable of making decisions by themselves, as well as being able to accept and absorb new technologies and apply them in their daily lives. Smart citizens are those who generate and benefit from the city’s human and social capital (Nam and Pardo, 2011).

Thus, characteristics like having an open mind, diversity and a deep cognitive ability are important issues for the smart city population. The city’s intelligence can be assessed, based on the population collective intelligence provided a smart city is thought of as a cluster of smart people (Zygiaris, 2013; Popescu, 2015).

Governance. Smart governance is based on transparency, public participation, cooperation and open access to data and information through the aid of digital technologies and tools. It represents a set of people, policies, practices, resources, social norms, technologies and information that interact in order to support government activities (Chourabi et al., 2012). This structure enables collaboration, data exchange, integration between services and communication within the city administration.

The smart city is focused on citizens and their needs, so one of its directives is to carry out public policies and partnerships with stakeholders, aiming at engaging the population in decisions and public services, so that they can express more directly their own interests. In other words, the purpose is to present a governance that can provide the services that citizens need, encourage participation and interact with all public and private agents (Caragliu et al., 2011; Khansari et al., 2013; Ojo et al., 2015; Cunha et al., 2016).

Therefore, an integration between policies, marketing, alliances and partnerships, which are some of the key elements in smart governance, should be pursued, providing greater autonomy for local authorities and emphasizing aspects of government transparency and accountability, in order to promote a greater sense of confidence in the population and motivate political participation (Albino et al., 2015; Khatoun and Zeadally, 2016).
Mobility. Smart mobility is based on the integration of transportation resources and the city’s infrastructure, enabling the management of the population’s demand flow. Furthermore, a wide range of alternatives should be sought, which includes having several transportation modes, such as buses, trains, individual transportation services and bicycles. This should be done considering the different types of special needs and integrating all areas of the city (Cunha et al., 2016).

Smart mobility aims, among its main objectives, to reduce costs and pollution (Benevolo et al., 2016), by encouraging fewer private vehicles, enabling a smaller expense for this modality, as well as the improvement in mobility flows. By using ICT tools, one can hope to optimize public transportation so that it is fast, safe and sustainable. Thus, it is vital to have a broad technological infrastructure supporting this system.

Furthermore, accessibility is also an essential aspect of a smart city, which includes the scope not only of transportation systems but also of information and technology systems throughout the area, providing real-time information for all citizens. Logistics in smart cities should be designed in a way to give priority to public, ecological and efficient transportation, which meets the demands of, not only the internal population but also the external, making connections with other areas around it and promoting greater social inclusion (Zygiaris, 2013; Letaifa, 2015).

A fair and balanced distribution of the urban transportation network would strengthen social cohesion, allowing better mobility and avoiding the isolation of modern urban ghettos (Ibrahim et al., 2015; Ferrara, 2016; Guerra, 2017).

Environment. Urban environments require a lot of resources and generate waste, so one of the keywords in smart cities is sustainability. A smart environment is one that promotes the reduction of impacts, caused by urbanization over nature, counting on the aid of technology, seeking smart alternatives to solve environmental management problems (Khansari et al., 2013; Zygiaris, 2013).

The main objectives are to promote greater use of renewable sources, while getting smaller consumption of natural resources through technological solutions that enable a smart measurement, as well as a better monitoring and control of pollution in the city. At the same time, it is important to have projects that increase the awareness of the population, consolidating the knowledge about sustainability. The environment in the smart city can be characterized by attractive natural conditions (climate, green space, among others), resource management and environmental protection efforts (Barrionuevo et al., 2012).

Living. Having a smarter living means to testify an increase in quality, accessibility, practicality and efficiency in the relationships with the city. It is the promotion of a smart management of healthcare demand through technology, which means less time spent waiting and more time spent on actions. It is, therefore, time optimization to provide a less stressful, easier, more prosperous and healthier living aided by technology to achieve it (Lombardi et al., 2012).

Smart living has as its basis all the aspects related to the standard of living, from the perception of security by the citizens, housing conditions, access to health resources and education (Giffinger et al., 2007; Letaifa, 2015). This even includes issues often seen as secondary, such as sports, tourism, culture and leisure. From this perspective, the goal is to make the city attractive for those who live in it, and for potential citizens. Thus, the focus is the quality of the integration with the city, intended for at greater social cohesion and a sense of belonging by the population.

2.3 Perceived usefulness and the intention to live in a smart city
Perceived usefulness is the degree to which individuals perceive that the use of a technology is useful and contributes to carry out activities with better quality and in a faster way.
Venkatesh and Bala (2008) and López-Nicolás et al. (2008) argue that perceived usefulness can positively affect behavioral intention. In this study, this construct has been adapted to the “intention to live in a smart city.” Similarly, the “perceived usefulness” can be affected by an antecedent variable, in this case the characteristics of smart cities.

The intention to live in a smart city, which is the dependent variable of this study, measures the degree to which individuals are interested and intend to use a new technology (Wu, 2011) and to recommend a friend to live in equipped cities with inherent characteristics of smart cities. Thus, the following hypotheses are verified:

$H_1(+).$ Perceived usefulness positively influences the intention to live in a smart city.

$H_2(+).$ Characteristics of smart cities positively influence perceived usefulness.

Based on the construction of the hypotheses, Figure 2 presents the theoretical model of this research.

### 3. Method
Data collection was carried out by convenience sampling, a non-probability sampling method, which limits the generalization of the research results (Malhotra, 2014). We conducted herein a survey based on theoretical aspects obtained in the systematic literature review phase divided and grouped into constructs, that is, issues that deal with the same aspect.

The data collection instrument consisted of closed questions. The five-point item Likert scale was used herein according to the respondents’ level of agreement or disagreement (1–totally disagree; 5–totally agree) in the assertions that were part of the theoretical model construction. For the demographic profile data (gender, age, educational level, household income and area of residence), we elaborated specific descriptive questions. Data collection took place in February and March 2018 with students from a Public Higher Education Institution in the city of São Paulo (it is worth noticing that the city of São Paulo was considered, in 2017, as one of the main Brazilian cities by the ranking Connected Smart Cities,

![Figure 2. Theoretical model](source: Own elaboration)
developed by Urban Systems). Data collection was carried out in person and through and electronic survey supported by QuestionPro research platform.

For the adaptation of the model to the Brazilian context, we used the reverse translation process of some assertions that already had a defined scale, and before applying the questionnaire, the pre-test was carried out with 30 individuals in order to verify if the research instrument had been clearly understood (Hair et al., 2010). After the test, 380 valid questionnaires were obtained, after having 88 excluded in the assessment process. In order to prepare the data for subsequent analysis, the database debugging consisted in the elimination of all records considered outliers and missing data of the sample. In order to verify discrepant values in the multivariate analysis, we opted for the use of Mahalanobis’ distance $D^2$ (Hair et al., 2010).

3.1 First phase: systematic literature review for preparing the indicators

In order to be sure of getting a high-quality ground for achieving the objectives proposed in this study, the methodology of the systematic literature review was used, which is a recognized method of scientific research adopted by researchers in several areas (Abidi et al., 2014). It is the research strategy that defines, from the selection to the analysis, all the necessary steps to carry out a bibliographic review accurately and reliably.

The systematic literature review was carried out through research queries in the collection of four main databases: EBSCO, ProQuest, Google Scholar and Web of Science. Through the terms “Smart Cities” and “Smart City,” a filtered search was conducted by the restrictions “full text,” “2007 – 2017” and “only articles” (where applicable) and were obtained a total of 856,738 studies on the four bases (Table I).

Of these selected articles, the ones that did not belong to scientific journals were excluded and a brief analysis was carried out for the title, abstract and keywords of the texts, searching for those that included smart city models and/or their concepts and aspects (“smart mobility,” “smart economy,” “smart governance,” “smart people,” “smart environment” or “smart living”). This selection led to 73 primary studies.

After conducting a more thorough observation of the studies found, it was possible to identify that there is a wide variety of uses and interpretations of “smart city” terms; it is also observed the lack of consensus on an in-depth general model of its characteristics. Thus, after the data synthesis, a total of 20 papers were chosen that guided this study design, addressing the smart city according to its aspects and/or concepts.

<table>
<thead>
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<th>Restrictions</th>
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</table>

Table I. Studies collected from databases
Therefore, after identifying a gap in the theoretical framework and due to the small number of studies carried out on all the aspects of the smart city, an exploratory study was carried out, through the development of a bibliographical review with a qualitative approach, as well as a field research with a quantitative approach. These were undertaken in order to develop an archetype of smart city aspects, thus, adding to the research in this area that is under development.

3.2 Second phase: multivariate analysis with estimation in structural equations
The instrument used in this research was developed with the purpose of identifying potential variables in scales, categories or analytical dimensions, among other classifications presented in the scientific literature. In the previous subsection (3.1), we demonstrated the construction of the theoretical scale aiming at identifying the interest centered on clusters that were common to each other, which are interpreted in relation to the observed variables. Subsequently, a range of measures for intrinsic factors was developed, that it somehow concentrated the original variables (Devellis, 1991; Hair et al., 2010).

In the present study, an exploratory factor analysis was not used, since by considering the separation by factors the original characteristics of the model would not be sustained by the theory (Giffinger et al., 2007). Therefore, a confirmatory factorial analysis (CFA) and a multigroup confirmatory factor analysis (MGCFA) were chosen. Then, as previous analyses indicated that the data distribution was not adherent to the Gaussian curve, we opted for the correlation matrix, using the partial least squares structural equation modeling (PLS–SEM), whose data were analyzed by the SmartPLS software (v 3.2.6). For the descriptive analysis step, the software Microsoft Excel and IBM SPSS were used.

4. Analysis of results
In this section, the respondents’ profile, the analysis of the descriptive questions of the questionnaire and the results obtained from the hypotheses made, as well as their statistical validity based on several indicators, are presented.

4.1 Characteristics of respondents
We collected data related to the respondents’ profile so that it could be possible to carry out the characterization of the sample that served as the basis for the assessment of the characteristics of smart cities model. Thus, information on gender, age, household income, educational level and area of residence are detailed in Table II.

Analyzing the entire sample data ($n = 380$), there was a predominance of males, comprising more than half of the respondents (58.2 percent; $n = 221$), and most of the sample is characterized by respondents aged 17–30 years (95.4 percent; $n = 333$).

Regarding income, according to the ABEP (Brazilian Association of Research Companies) classification, the predominant economic stratum was the B2 (28.7 percent; $n = 109$), followed by classes C1 (25 percent; $n = 95$) and C2 (14.5 percent; $n = 55$), from R$1,625.00 to 2,705.00. Moreover, it was found that most of the respondents have higher education in progress (84.2 percent; $n = 320$), many students have already got another university degree, and regarding the residence area, a large predominance of respondents who live in the metropolis was observed (64.2 percent; $n = 244$).

4.2 Assumptions of the model “characteristics of smart cities”
In the multivariate analysis technique that uses metric variables and statistical tests, the multivariate normality is the essential requirement for its application (Hair et al., 2014). The normality of data was checked by the Kolmogorov–Smirnov test and the respective $p$-value of each indicator resulting in $p < 0.001$. Regarding the predictor variables related to
the latent variable “intention to live in a smart city,” it was possible to observe that all the relations of the model are bivariate and there is no multicollinearity incidence in the structural level (variance inflation factor (VIF) = 1). Regarding the level of indicators (items), all values of VIFs were below 5, the lowest VIF was 1.082 and the highest 1.936; this outcome was already expected, as the items are reflective to suit the model (average variance extracted (AVE) and composite reliability (CR)) indicated in Table III.

After the first iteration, the results of the factorial loads of the measurement items obtained by each of the latent variables were obtained. It was observed that not all values of factor load measured had results above 0.5. In this case, it was necessary to eliminate some

<table>
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<tr>
<th></th>
<th>Sample1</th>
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<th>Sample2</th>
<th>%</th>
<th>Total</th>
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<td></td>
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<tr>
<td>Lower than R$768.00</td>
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<tr>
<td>From R$768.01 to 1,625.00</td>
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<td>7.9</td>
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<td>24</td>
<td>6.3</td>
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<tr>
<td>From R$1,625.01 to 2,705.00</td>
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<td>14.7</td>
<td>27</td>
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<td>25.8</td>
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<tr>
<td>From R$9,254.01 to 20,888.00</td>
<td>20</td>
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<td>23</td>
<td>6.1</td>
</tr>
<tr>
<td>Total</td>
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<td>100</td>
<td>190</td>
<td>100</td>
<td>380</td>
<td>100</td>
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<td>142</td>
<td>74.7</td>
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<td>16.3</td>
<td>56</td>
<td>14.7</td>
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<td>7</td>
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<td>0.5</td>
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<td>0.5</td>
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<tr>
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<td>12.1</td>
<td>2</td>
<td>1.1</td>
<td>25</td>
<td>6.6</td>
</tr>
<tr>
<td>Total</td>
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<td>100</td>
<td>190</td>
<td>100</td>
<td>380</td>
<td>100</td>
</tr>
</tbody>
</table>

**Source:** Data from this study

<table>
<thead>
<tr>
<th></th>
<th>Composite reliability (CR)</th>
<th>Average extracted variance (AVE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy</td>
<td>0.788</td>
<td>0.554</td>
</tr>
<tr>
<td>People</td>
<td>0.750</td>
<td>0.501</td>
</tr>
<tr>
<td>Governance</td>
<td>0.799</td>
<td>0.570</td>
</tr>
<tr>
<td>Mobility</td>
<td>0.771</td>
<td>0.533</td>
</tr>
<tr>
<td>Environmental</td>
<td>0.806</td>
<td>0.510</td>
</tr>
<tr>
<td>Living</td>
<td>0.796</td>
<td>0.506</td>
</tr>
</tbody>
</table>

**Source:** Data from this study
variables, and then, because of the convergent and discriminant validity adjustments, 16 measurement items (indicators) were excluded altogether, which enabled the adequacy of the model according to Figure 3. The latent variable “characteristics of smart cities” of second order had operational definitions of first order: “economy,” “governance,” “people,” “environmental,” “living” and “mobility.”

Although it may seem intriguing, the reduction of the variables (from 35 to 19, or a reduction of 46 percent) did not imply in the loss of the quality of the proposed model, since this is common in the SEM, mainly because the objective of the research is to detect the causal modeling, increasing the parsimony and, at the same time, reducing residual errors.

There was no capitalization in the case (chance capitalization), since a validation sample was used. The total sample was 380, two samples were randomly separated, Sample1 and Sample2, each with \( n = 190 \). As criterion, Sample1 was used to suit the model, and Sample2 was used to validate the model.

Furthermore, the items of scales or analytical dimensions proposed in this study indicated that they were more specific and less general, since they focused on a sample containing young individuals, which makes it possible to bring as a contribution a resulting scale with specific characteristics to the young university students (Appendix).

4.3 Assumptions of “characteristics of smart cities” model related to “perceived usefulness” and “intention to live in a smart city”

The convergent validity demonstrates the extent to which the latent variable correlates with the items chosen to measure that variable (convergent validity is the degree of confidence we have that a trait is well measured by its indicators). The next step was to examine the CR, AVE and the quadratic correlations between the constructs presented in Table IV.

Since all the variables of the questionnaire use the same measurement scale, the coefficient is calculated on the individual items’ variances (Malhotra, 2014). The CR consists of the assessment performed as from the results of the CFA model for the measurement

Figure 3.
Proposed model: “characteristics of smart cities”

Source: Own elaboration
coefficients and the measurement errors. Thus, the composite reliabilities ranged between 0.762 and 0.878, which is considered excellent, for values equal to or greater than 0.70 are considered highly acceptable.

For this model, the AVEs ranged between 0.522 and 0.780. Accordingly, all the latent variables presented average extracted variance higher than 50 percent, which reaches the criteria of Chin (1998) for indicating the existence of convergent validity.

In this study, the $R^2$ value showed that the model had accuracy and predictive relevance in all constructs. In order to analyze the structural model, it was necessary to evaluate the relationship among the constructs through collinearity, significance of the paths coefficients, coefficient of determination ($R^2$) and predictive relevance ($Q^2$). The model assessment includes the relationship between indicators and variables, using multiple criteria at its trial (Hair et al., 2014). According to the criteria used for assessing the accuracy of the adjusted model, $Q^2$, the constructs “economy,” “people,” “governance,” “mobility,” “environment,” “living,” “perceived usefulness” and “Intent to live in a smart city” were considered with adequate accuracy, due to the existence of predictive relevance of the model in relation to the latent endogenous variables, since they produced values greater than zero.

The $f^2$ is obtained by including and excluding constructs of the model (one to one). It evaluates how useful each construct is for the model adjustment. Values of 0.02, 0.15 and 0.35 are considered small, medium and large, respectively (Hair et al., 2014). The $f^2$ values are obtained by reading the commonalities.

Discriminant validity involves the correlation between the constructs of the theoretical model. The discriminant validity assessed the items that reflect the factor, or that are correlated with other factors. In this study, the extracted average variances were greater than or equal to the square of the correlation between the factors, as presented in Table V, with the definitive criterion of Fornell-Larcker (1981), with all factorial loads of each

<table>
<thead>
<tr>
<th>Construct</th>
<th>Composite reliability (CR) &gt; 0.7</th>
<th>Average variance extracted (AVE) &gt; 0.5</th>
<th>$R^2$</th>
<th>$Q^2$</th>
<th>$f^2$</th>
<th>No. of items</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.522</td>
<td>0.327</td>
<td>0.160</td>
<td>0.486</td>
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</tr>
<tr>
<td>People</td>
<td>0.766</td>
<td>0.523</td>
<td>0.560</td>
<td>0.279</td>
<td>1.285</td>
<td>3</td>
</tr>
<tr>
<td>Governance</td>
<td>0.787</td>
<td>0.552</td>
<td>0.504</td>
<td>0.264</td>
<td>1.006</td>
<td>3</td>
</tr>
<tr>
<td>Mobility</td>
<td>0.775</td>
<td>0.538</td>
<td>0.581</td>
<td>0.297</td>
<td>1.388</td>
<td>3</td>
</tr>
<tr>
<td>Environmental</td>
<td>0.814</td>
<td>0.523</td>
<td>0.663</td>
<td>0.328</td>
<td>1.965</td>
<td>4</td>
</tr>
<tr>
<td>Living</td>
<td>0.780</td>
<td>0.543</td>
<td>0.563</td>
<td>0.266</td>
<td>1.098</td>
<td>3</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>0.878</td>
<td>0.706</td>
<td>0.523</td>
<td>0.041</td>
<td>0.068</td>
<td>3</td>
</tr>
<tr>
<td>Intention to live in a smart city</td>
<td>0.876</td>
<td>0.780</td>
<td>0.649</td>
<td>0.484</td>
<td>1.852</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table IV.** Convergent validity

| (1) Economy              | 0.722                           | 0.723                                |
| (2) Environment          | 0.339                           | 0.723                                |
| (3) Governance           | 0.319                           | 0.443                                |
| (4) Intention to live in smart cities | 0.323 | 0.200 | 0.200 | 0.883 |
| (5) Living               | 0.231                           | 0.399                                |
| (6) Mobility             | 0.369                           | 0.387                                |
| (7) People               | 0.442                           | 0.229                                |
| (8) Perceived usefulness | 0.275                           | 0.086                                |

**Table V.** Discriminant validity

**Source:** Data from this study
indicator displaying values above 0.5. The measurement model analysis must precede the analysis of the relationships between the constructs or latent variables.

Based on Figure 4, the initial model did not require further iterations because all the indicators presented AVE values higher than 0.5. It is a reflexive model, in which the relationship direction between variables is positioned as from the constructs (latent variables)–for the indicators (manifest variables).

The construction of path diagrams of established relationships was carried out, which is a graphic expression of cause and effect established in the theoretical model, in order to allow the visualization of the relationships derived from the constructs. This diagram allows describing the relationships of cause and effect identified in the relationships between dependent variables (also called endogenous variables) and independent variables (identified as exogenous), as well as verifying the relationship between the constructs.

The measurement of the construct “intention to live in a smart city” was carried out based on two indicators, one of them tested by Wu (2011) and the other developed by the authors. This procedure was carried out so that there was no attenuation in the correlation, which in the PLS–SEM literature has been referred to as "consistency at large," so the PLS results approach correct values (non-biased) as increases the number of items by latent variable (Chin and Newsted, 1999).

The model was estimated using the bootstrapping technique, comparing the original sample with the generated samples (Chin, 1998). Accordingly, other 380 subsamples were generated, and the values of t-test were observed and the factorial loads of the observable variables are presented in Table VI.

4.4 Multigroup analysis
To test whether the proposed model is applicable, a multigroup analysis was conducted with both samples: Sample1 and Sample2. MGCFA is a technique of SEM that evaluates the extent to
### Operational definition of characteristics of smart cities

<table>
<thead>
<tr>
<th>Characteristics of smart cities → economy</th>
<th>Sub-sample mean (Sample1)</th>
<th>Sub-sample mean (Sample2)</th>
<th>SE (Sample1)</th>
<th>SE (Sample2)</th>
<th>Student's t-test (Sample1)</th>
<th>Student's t-test (Sample2)</th>
<th>p-value (Sample1)</th>
<th>p-value (Sample2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original sample (β) (Sample1)</td>
<td>0.627</td>
<td>0.556</td>
<td>0.634</td>
<td>0.563</td>
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<td>0.069</td>
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</table>

<table>
<thead>
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<th>Sub-sample mean (Sample2)</th>
<th>SE (Sample1)</th>
<th>SE (Sample2)</th>
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<td>0.655</td>
<td>0.775</td>
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<td>0.776</td>
<td>0.749</td>
<td>0.037</td>
<td>0.046</td>
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<table>
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<td>0.655</td>
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<tr>
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<td>0.776</td>
<td>0.749</td>
<td>0.037</td>
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<td>20.694</td>
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<th>Sub-sample mean (Sample2)</th>
<th>SE (Sample1)</th>
<th>SE (Sample2)</th>
<th>Student's t-test (Sample1)</th>
<th>Student's t-test (Sample2)</th>
<th>p-value (Sample1)</th>
<th>p-value (Sample2)</th>
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<td>0.824</td>
<td>0.797</td>
<td>0.030</td>
<td>0.034</td>
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<tr>
<td>Original sample (β) (Sample2)</td>
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<td>0.747</td>
<td>0.710</td>
<td>0.748</td>
<td>0.047</td>
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<td>16.620</td>
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</table>

<table>
<thead>
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<th>Sub-sample mean (Sample2)</th>
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<th>SE (Sample2)</th>
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<th>Student's t-test (Sample2)</th>
<th>p-value (Sample1)</th>
<th>p-value (Sample2)</th>
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</thead>
<tbody>
<tr>
<td>Original sample (β) (Sample1)</td>
<td>0.627</td>
<td>0.556</td>
<td>0.634</td>
<td>0.563</td>
<td>0.050</td>
<td>0.069</td>
<td>12.560</td>
<td>8.095</td>
</tr>
<tr>
<td>Original sample (β) (Sample2)</td>
<td>0.738</td>
<td>0.780</td>
<td>0.742</td>
<td>0.782</td>
<td>0.038</td>
<td>0.030</td>
<td>19.300</td>
<td>25.954</td>
</tr>
</tbody>
</table>

### Hypotheses of the research

**H1(+):** characteristics of smart cities → perceived usefulness

<table>
<thead>
<tr>
<th>Perceived usefulness → intention to live in a smart city</th>
<th>Sub-sample mean (Sample1)</th>
<th>Sub-sample mean (Sample2)</th>
<th>SE (Sample1)</th>
<th>SE (Sample2)</th>
<th>Student's t-test (Sample1)</th>
<th>Student's t-test (Sample2)</th>
<th>p-value (Sample1)</th>
<th>p-value (Sample2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original sample (β) (Sample1)</td>
<td>0.378</td>
<td>0.340</td>
<td>0.385</td>
<td>0.325</td>
<td>0.069</td>
<td>0.054</td>
<td>5.509</td>
<td>4.332</td>
</tr>
<tr>
<td>Original sample (β) (Sample2)</td>
<td>0.837</td>
<td>0.782</td>
<td>0.836</td>
<td>0.786</td>
<td>0.025</td>
<td>0.031</td>
<td>33.292</td>
<td>25.292</td>
</tr>
</tbody>
</table>

**Note:** All structural coefficients were significant (p < 0.001)

**Source:** Data from this study
which the configuration and parameters of a particular psychometric instrument are invariant (equivalent) for different groups, helping to analyze the stability of the model (Byrne et al., 1989).

The multigroup analysis performed a general simultaneous test of the model between the two groups (Sample 1 and Sample 2), showing equivalence between the samples and presenting a significance level with $p < 0.001$ in all structural paths ("operational definition of characteristics of smart cities" and the "hypotheses of the research").

The results of the significance analysis of the paths indicated that all hypotheses were accepted considering $p < 0.001$, since there was not a significant difference between the original sample and the subsamples generated by the statistical technique with the critical limits for Student’s $t$-test.

When the operational definitions of "characteristics of smart cities" are analyzed, the path analysis "characteristics of smart cities and environment" was accepted with the highest $\beta$ in both samples: Sample1 ($\beta = 0.822$) and Sample2 ($\beta = 0.793$) of all relationships. This is related to the use of ICTs to better protect and manage the environmental resources and the related infrastructure, generating greater sustainability. In this context, the developed technologies in that area are perceived as factors that drive the city's efficiency, enabling the best use of resources and reducing environmental impact, for example improving air quality.

The participants of this study indicated that the theme reflected its urgency, indicating that it is essential that political leaders, social movements, public managers, researchers, civil society organizations and entrepreneurs jointly delineate a common medium- and long-term agenda that articulate the public policies to the new ICTs in order to make cities smarter and sustainable.

Citizens of a large metropolis such as São Paulo (most of the selected sample) face daily problems such as traffic jams, poor public services and poor sanitation, as well as air, water and street pollution, which brings up disorders and concerns that require feasible solutions. Before this scenario, the media, schools and universities and governments could allocate efforts on programs aimed at raising the public’s awareness on the adoption of sustainable attitudes with the support of new ICTs. Similarly, the business market could also make a commitment to public education for conscious consumption.

The environmental component also aims at sustainable buildings and new ways to capture energy. This issue goes through the academia, and makes the young students reflect on alternatives to lessen the human-made impacts on the environment. Some technologies, such as sensors, can measure variables like temperature, humidity and pressure, giving real-time information about the condition and quality of food and pharmaceuticals. The sensors present in everything, from lampposts and bins to public services, will demonstrate the savings achieved through automated routines in this control panel accessible to all residents. These savings will be directed to improvements in the structure and services offered (public or private).

On the other hand, still addressing the operational settings of characteristics of smart cities, the relationship of the path analysis “characteristics of the smart cities and economy” was the one with the lowest $\beta$ in both Sample1 ($\beta = 0.627$) and Sample2 ($\beta = 0.556$) among all relationships, confirming that a smart city is an innovative urban ecosystem characterized by the widespread use of ICTs in the management of its resources and structure. However, it is necessary that the concept of the economy is more widespread with access and information for the public who participated in the survey, so that they can participate more actively in issues aligned with the innovative spirit, entrepreneurship, productivity, labor market, international integration and the ability for transformation. In addition, an important aspect of this construct is associated with competitiveness, it is therefore necessary to invest in the creation of these innovative environments (e.g. rooms or coworking spaces) so that one can boost the engagement of young people.
The results obtained in $H1(+)$ and $H2(+)$ made it possible to understand that the observed sample considers that the influence on the intention to live in a smart city was explained with $R^2 = 64.9$ percent. The construct perceived usefulness expands the possibilities of using smart cities' technologies, and many of these technologies have been already used by this public in its day-to-day tasks, as well as recommending that people reside in cities that have a structure to embrace the projects of smart cities.

5. Conclusions
After the results obtained in the data analysis, it is possible to notice that objective of this study was achieved, since it was possible to identify the intention of living in a smart city as from its characteristics in the individual perception by the young public based on the proposal of an expanded model developed in the systematic review of literature.

The involvement of university students in society is growing in the urban view due to the attractions of a large metropolis. In addition, this allows this public to become a powerful and comprehensive intelligence in the city.

Technology can contribute to a new form of activism, providing the right environment and ICT tools to make it possible. This opens up possibilities for imagining that even demonstrations or protests that are well known today will become outdated as people will have greater real-time interactivity in communications with the city.

It is possible to observe a positive development of society with the implementation of the smart cities project, because it provides conditions for citizens to become more inclusive. There are problems, but the transformation takes place in a short time. The information is identified quickly and can be directed in favor of the people, leading how they can participate in their cities’ decisions.

Digital technologies are particularly suitable to help civil action to mobilize large communities, share resources and distribute power. This opens up opportunities for technology entrepreneurs and innovators in the civil society to develop digital solutions to social challenges, leveraging henceforth a collective intelligence and citizens’ participation. This allows that the open data will be able to create greater transparency about public activities and can also serve as input for the generation of knowledge, and smart cities can benefit from this process. This is the type of shared economy geared to all, that according to Almirall et al. (2017) needs to be promoted and expanded in the near future.

Smart solutions are the differentiating parts of smart cities from the combination of disruptive technologies, social innovations and new ways of using data. Viewed in this way, the public that participated in this research is rapidly influenced by the process of behavior change. Smart cities can only exist due to the natural need of citizens who experience a more digital reality and move into a digitally growing economy. In this sense, young people become an important social group that can play a leading role in the promotion of digital education.

The results observed in this research have indicated that the target audience engagement in the innovation processes of public life will depend, in general, on the success in the field of innovation and on the collaborative process of a smart city that evolves in environments that encourage the discovery and generation of ideas.

Finally, this research provides support so that there is continuity or even replication of the model in samples with other audiences. A limitation of the research was the non-accomplishment with the use of the face validation method of the instrument after the systematic review of literature with experts of this area prior to conducting the field research with the selected sample. However, this did not result in loss of quality of the proposed model, since the SEM as from the PLS helped to detect causal modeling, increasing parsimony and, at the same time, reducing residual errors.
References


Intention to live in a smart city


Further reading
**Appendix**

<table>
<thead>
<tr>
<th>Latent variable</th>
<th>Item</th>
<th>Meaning in the literature</th>
<th>Description of the statements</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy</td>
<td>eco_2</td>
<td>Productivity</td>
<td>High capacity and production efficiency, resulting from the good performance of economic agents and relationships within the market (e.g. outstanding problem solving)</td>
<td>Zygias (2013); Anttila et al. (2013)</td>
</tr>
<tr>
<td></td>
<td>eco_5</td>
<td>Innovation</td>
<td>Creative competence of economic agents and individuals of society to devise new content and develop new ideas</td>
<td>Strapazzon (2009); Angelidou (2015)</td>
</tr>
<tr>
<td></td>
<td>eco_6</td>
<td>Flexibility</td>
<td>Ability to adapt to new scenarios, to unforeseen events, to opportunities and to adverse situations</td>
<td>Strapazzon (2009)</td>
</tr>
<tr>
<td>People</td>
<td>peo_1</td>
<td>Engagement</td>
<td>Participatory population, consisting of proactive individuals capable of assimilating new ideas and taking initiatives</td>
<td>Nam and Pardo (2011); Barrioneuvo et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>peo_4</td>
<td>Open mind</td>
<td>Receptivity to new ideas and divergent thoughts, to the discussion and deconstruction of concepts, flexibility and tolerance in social relationships</td>
<td>Giffinger et al. (2007); Nam and Pardo (2011); Letaifa (2015)</td>
</tr>
<tr>
<td></td>
<td>peo_6</td>
<td>Knowledge</td>
<td>Individuals with the ability to understand social, economic and political events more deeply and formulate new ideas</td>
<td>Zygias (2013); Popescu (2015)</td>
</tr>
<tr>
<td>Governance</td>
<td>gov_1</td>
<td>Population participation</td>
<td>Efficient inclusion of the population in government decisions, greater representation of their interests and their involvement in city administration</td>
<td>Caragliu et al. (2011); Khansari et al. (2013); Ojo et al. (2015)</td>
</tr>
<tr>
<td></td>
<td>gov_3</td>
<td>Partnerships</td>
<td>Government cooperation in order to better meet people’s needs and desires, unify initiatives and reduce costs</td>
<td>Chourabi et al. (2012); Lee et al. (2013)</td>
</tr>
<tr>
<td></td>
<td>gov_4</td>
<td>Transparency</td>
<td>Transparency of access to information relevant to public management or that impact citizens in some way, with visibility and intelligibility of the data</td>
<td>Albino et al. (2015); Khatoun and Zeadally (2016); Cunha et al. (2016)</td>
</tr>
<tr>
<td>Mobility</td>
<td>mob_1</td>
<td>Transportation</td>
<td>Availability of safe and effective public transportation (e.g. subway) and general locomotion modes (e.g. taxi, plane)</td>
<td>Ibrahim et al. (2015); Guerra (2017)</td>
</tr>
<tr>
<td></td>
<td>mob_4</td>
<td>Sustainability</td>
<td>Greater efficiency of transportation and availability of alternative means (e.g. bike paths)</td>
<td>Cunha et al. (2016)</td>
</tr>
<tr>
<td></td>
<td>mob_5</td>
<td>Urban planning</td>
<td>Optimized use of the land and city spaces as a whole, efficient infrastructure of public transportation, highways, bike paths</td>
<td>Zygias (2013); Letaifa (2015)</td>
</tr>
<tr>
<td>Environment</td>
<td>env_2</td>
<td>Ecological awareness</td>
<td>Knowledge and understanding of the effects that impact the environment and the search for its minimization</td>
<td>Zygias (2013)</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Latent variable</th>
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<th>Meaning in the literature</th>
<th>Description of the statements</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>env_3</td>
<td>Pollution control</td>
<td>Setting of practices to prevent the emission of pollutants or their minimization, in order to reduce the consequences for the environment and society</td>
<td>Zygariaris (2013)</td>
<td></td>
</tr>
<tr>
<td>env_4</td>
<td>Efficient management of natural resources</td>
<td>Management to minimize expenditures, such as the planned management of green areas and the efficient use of resources (e.g. water and electricity)</td>
<td>Khansari et al. (2013)</td>
<td></td>
</tr>
<tr>
<td>env_5</td>
<td>Efficient waste management</td>
<td>Efficient management of waste produced in the city, recycling, use of renewable energy sources, aiming at the reduction of waste production</td>
<td>Barrionuevo et al. (2012)</td>
<td></td>
</tr>
<tr>
<td>Living</td>
<td>liv_2 Health</td>
<td>Access to medical facilities (e.g. hospitals) and medical resources (e.g. medicines), fine environmental quality (e.g. level of air pollution) and incentives for healthy life</td>
<td>Giffinger et al. (2007)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>liv_3 Quality of living</td>
<td>Residential areas having first-rate infrastructure (e.g. water, electricity), excellent accessibility conditions (e.g. public transportation) and pollution-free (e.g. noise)</td>
<td>Lombardi et al. (2012)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>liv_4 Education</td>
<td>Public access to knowledge, general education, libraries and archives</td>
<td>Letaifa (2015)</td>
<td></td>
</tr>
<tr>
<td>Perceived</td>
<td>pu_1 Initiatives</td>
<td>I believe that initiatives implementation of technologies and proposals related to smart cities will bring benefits as from their use in my city</td>
<td>Adapted from Venkatesh and Bala (2008) and López-Nicolás et al. (2008)</td>
<td></td>
</tr>
<tr>
<td>usefullness</td>
<td>pu_2 Living</td>
<td>Compared to ordinary cities, I agree that there would certainly be benefits of living in a city that uses such smart cities technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>pu_3 Assessment</td>
<td>I believe that smart cities are an improvement over the current standards of their use in the cities’ quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention to</td>
<td>int_1 Intend to live in a smart city</td>
<td>I intend to adhere to smart cities technologies</td>
<td>Adapted from Wu (2011)</td>
<td></td>
</tr>
<tr>
<td>live in a</td>
<td></td>
<td>I intend to recommend living in cities equipped with inherent resources of smart cities</td>
<td>Authors</td>
<td></td>
</tr>
<tr>
<td>smart city</td>
<td>int_2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Own elaboration

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**Corresponding author**  
Luis Hernan Contreras Pinochet can be contacted at: luis.hernan@unifesp.br

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Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo, SP, Brazil
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Universidade Federal de São Paulo, São Paulo, SP, Brazil
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Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo, SP, Brazil

ISSN 2177-8736
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