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Technical Article

Innovation dynamics of the state basic sanitation companies

Dinâmica inovativa das companhias estaduais de saneamento básico

Beatriz Couto Ribeiro[1]*, Adriana Bin[1], Milena Pavan Serafim[1]

ABSTRACT

Despite the few empirical research, innovation in the Brazilian Basic Sanitation sector is an increasingly debated topic, Therefore, this study aimed to explore the structures and activities of Brazilian basic sanitation companies in research, development, and innovation (RDI). To achieve this the research conducted an empirical study of the state companies of basic sanitation, hereafter called CESBs, through a survey based on Innovation Research (Pintec) and secondary data. The survey examines the following aspects: introduction of product, process, organizational and marketing innovation; types of innovative activities developed; funding for RDI; cooperation for RDI; intellectual property; impacts of innovations; organizational structure for innovation management; innovation management system; and barriers to innovation management. The results indicate that the CESBs have structures and develop actions in RDI; however, these activities are not strategic for the companies analyzed.

Keywords: basic sanitation; research; development and innovation; state company of basic sanitation.

RESUMO

A inovação no setor de saneamento básico brasileiro é um tema crescentemente debatido, apesar da existência de pouca pesquisa empírica no tema. Nesse sentido, o presente artigo visa contribuir com essa discussão ao explorar as estruturas e atividades de empresas de saneamento básico brasileiras em pesquisa, desenvolvimento e inovação (PDI). Para isso, a pesquisa realizou um estudo empírico das companhias estaduais de saneamento básico (CESBs) por meio de questionário baseado na Pesquisa de Inovação (Pintec) e dados secundários. Por meio desses dados, foram analisados os seguintes aspectos: introdução de inovação de produtos, processos organizacionais e de *marketing*; tipos de atividade inovativa praticados; fontes de financiamento de PDI; cooperações para PDI; propriedade intelectual; impactos das inovações; estrutura organizacional para a gestão da inovação; sistema de gestão da inovação; e barreiras para a gestão da inovação. Os resultados apontam que as CESBs possuem estruturas e desenvolvem ações voltadas à PDI, entretanto essas atividades não são estratégicas para as empresas analisadas.

Palavras-chave: saneamento básico; pesquisa; desenvolvimento e inovação; companhias estaduais de saneamento básico.

INTRODUCTION

Basic sanitation, which includes water supply and sewage services, has received wide prominence in the national and international scene in recent decades, mainly due to concerns about the decrease in the availability of water resources, preservation of the environment, and health care (HELLER; NASCIMENTO, 2005). Such concerns intensified after the COVID-19 pandemic, precisely because the lack of basic sanitation increased the challenge in controlling the spread of the virus (WHO; UNICEF, 2020).

In addition to the emergency caused by the pandemic, the supply of water and sewage has been seen as a fundamental infrastructure to improve the quality of life and conservation of the environment. In Brazil, data from the National System of Information on Sanitation (*Sistema Nacional de Informações sobre o Saneamento — SNIS* 2018) (BRASIL, 2019) indicate that 83.6% of the population is served through the general supply network and only 53.2% of the population has its sewage collection from a general network; therefore, much effort still needs to be done in order to achieve the universalization of these services.

In this context, the generation and implementation of innovations by companies in the sector becomes a key instrument to achieve the primary objectives of sanitation, i.e., universalization, mitigation of environmental impact, and cost reduction, as well as to respond to new trends, such as reuse, biogas production, creation of decentralized sewage treatment systems, among others (LARSEN *et al.*, 2016).

In this context, basic sanitation companies, which are the providers of water supply and sewage services, are increasingly pressured to conduct efforts to develop and/or adapt technologies in their current business for the implementation of these objectives.

In contrast, some authors pointed out that this growing demand for the generation of innovations by utilities is contradictory (PAVITT, 1984; MIOZZO;

[1]Universidade Estadual de Campinas – Limeira (SP), Brazil.
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SOETE, 2001), considering that these sectors are natural monopolies and that it has a technological pattern characterized as of slow change, with high investment cost, and with less flexibility to fractionate their investments (GALVÃO; PAGANINI, 2009). Such peculiarities contributed to utilities that are not developing culture-prone innovation (WEHN; MONTALVO, 2018).

Due to the abovementioned characteristics, the literature focused on discussing technological development and innovation, which classifies basic sanitation as *supplier-dominated* (PAVITT, 1984; MIOZZO; SOETE, 2001), because companies in the sector carry out their technological *catching-up* through the purchase of inputs, components, and equipment from its suppliers (GAVA, 2015; INTIMA, 2015).

Consequently, the aforementioned factors contribute to companies being highly averse to investment in research, development, and innovation (RDI), given the high risks related to this type of investment (KIPARSKY *et al.*, 2013). As a result, they develop few internal competencies in innovation management activities aimed at integrating these innovations into their organizational activities (LARSEN *et al.*, 2016).

In this sense, research projects have been developed to understand the innovative dynamics of the basic sanitation sector (WEHN; MONTALVO, 2018), especially through empirical research that investigate the structures and activities of innovation in companies operating in basic sanitation sector in different contexts (GEBAUER; SAUL, 2014; YINUSA; WEHN, 2016; MORO, 2019).

Particularly in Brazil, studies have investigated this aspect in a fragmented way. Venditti and Pamplona (2020) analyzed cooperation for innovation in sanitation companies, and Gava (2015) investigated the practice of open innovation in these companies, but there are still many other aspects to explore. Given the limited number of research, we focused in analyzing how Brazilian basic sanitation companies have developed structures and actions aimed at RDI in a broader way. With this aim, the research uses the state companies of basic sanitation, hereafter called CESBs, as its object of study.

With this purpose, our paper is structured into three sections (Methodology, Results and Discussion, and Conclusions), in addition to the Introduction section. The "Methodology" section presents and justifies the adopted focus based on the CESBs, as well as explains the methodological approach applied. The "Results and Discussion" section presents and discusses the results obtained and is divided into nine subsections, each of which is dedicated to the following aspects:

- introduction of product, process, organizational and marketing innovation;
- types of innovative activities developed;
- funding for RDI;
- cooperation for RDI;
- intellectual property;
- impacts of innovations;
- organizational structure for innovation management;
- innovation management system;
- barriers to innovation management.

Finally, the conclusions, limitations, and suggestions for future studies are presented in the final section.

METHODOLOGY

Despite the wide diversity of legal nature of Brazilian sanitation companies – Direct Administration, Municipal Authority, Private Company, Social Organization, and State Company – our research considered CESBs as the object of study, because the literature (CANÇADO; COSTA, 2002) designated them as the central *locus* of technological innovation in the sanitation sector, given their leading role on research and development (R&D), due to their large size and demand when compared with the other type of companies.

This characteristic can be verified since CESBs are responsible for 78.9% of Brazilian cities' water supply and 56.5% of sewage services, reaching more than 125 million Brazilians citizens, which represent around 60% of the population (SNIS, 2017). The importance of the large-sized companies for conducting R&D activities is present in the literature on innovation economics, and it is based on the observation that large companies have greater availability of capital and more qualified employees and, therefore, are better able to conduct a greater volume of activities aimed at scientific and technological advancement (FREEMAN, 1975; ALBUQUERQUE, 2011).

Therefore, to verify how Brazilian sanitation companies have developed structures and actions aimed at promoting innovation, primary data were collected through a survey applied to CESBs, and secondary data were collected from Questel Orbit that consists of an application dedicated to obtaining patent information.

The survey was formulated based on the indicators used in Pintec, which is conducted every 3 years by the Brazilian Institute of Geography and Statistics (IBGE) to measure the innovation activities of Brazilian companies and covers the sectors of industry, services, electricity, and gas. Thus, the survey considered the following indicators to analyze the efforts and results of RDI in concession companies between the years 2014 and 2016:

- product, process, organizational, and marketing innovation;
- innovative activities;
- sources of funding for R&D;
- cooperation for R&D innovation;
- intellectual property;
- impacts of innovations.

Data regarding the patents produced by all CESBs were obtained through secondary data from Questel Orbit because although CESBs were inquired about applications for the protection of intellectual property rights (IPR) filed and/or granted – in Brazil or abroad – since 2000, the answers obtained were very scarce. It is unknown if this is related to the absence of patents (or their rarity) or due to the lack of information provided by those who answered the questionnaire. Hence, this secondary data collection covered the period of 2000–2017.

In addition to the subjects treated in Pintec, the research also explored additional dimension related to innovation management:

- organizational structure for innovation management;
- innovation management system; and
- barriers to innovation management.

The inclusion of this topic was based on the research of Boer *et al.* (2014) and Salles-Filho *et al.* (2017) who considered this aspect when comprehending the technological dynamics of companies.

After the online questionnaire was created, it was sent to 25 CESBs. Requests for filling it were carried out via telephone for over 8 weeks, and 13 responses were obtained (52.0% of the total) (Figure 1), which consist in a higher number than that obtained in other surveys (GAVA, 2015; VENDITTI & PAMPLONA, 2020).

It is also noteworthy that the survey was answered by CESBs employees assigned to departments/areas dedicated to planning or innovation and technology. These employees had an average of 18 years of employment with CESBs.

From the collection of these data, its aggregate analysis was conducted in the light of Pintec 2014 (based on the data collection of 2012–2014 interval) and 2017 (based on the data collection of 2015–2017 interval), which analyzed the Brazilian electricity and gas sectors. The interest in comparing data from CESBs and Pintec 2014/2017 is due to the fact that these studies analyze the innovative activities of companies in other public utility sectors, which are also characterized by the literature as having a similar innovative dynamic and are as well classified as supplier-dominated. Therefore, it consists an alternative measure of comparison given the lack of national and international research on the innovative dynamics of the sector.

RESULTS AND DISCUSSION

The results obtained through the survey and secondary data are presented and discussed below. These results are organized in subsections, according to each of the items evaluated in relation to the CESBs that responded to the research.

Source: Own elaboration.

Figure 1 – CESBs in the sample.

Product, processes, organizational, and marketing innovation

Regarding innovation in products and processes among the CESBs consulted, 84.6% of them innovated. It is noteworthy that the responses to our survey are self-declaratory and were obtained by summing the percentages of "product and process," "product only," and "process only" innovations (Figure 2) through the introduction of a new product and/or process in the last 3 years.

This rate is extremely high when compared to the country's overall innovation rates of 36.0% and 33.6%, according to the Pintec data 2014 and 2017, and even when compared to the innovation rates of 29.3% and 28.5% in regulated sectors, i.e., "electricity" and "gas," respectively. Another noteworthy aspect is that the innovation occurs in both products and processes, which differs from companies operating in the electricity and gas sectors, which are predominantly process innovations.

Regarding the degree of novelty of the innovations, it is found that most of them have a low novelty level, since the classification "new for the company, but existing in the national market" is predominant. Despite this, product innovations stand out for having a higher degree of novelty compared to processes innovation (Figure 3), a trend that is also present in Pintec 2014 and 2017.

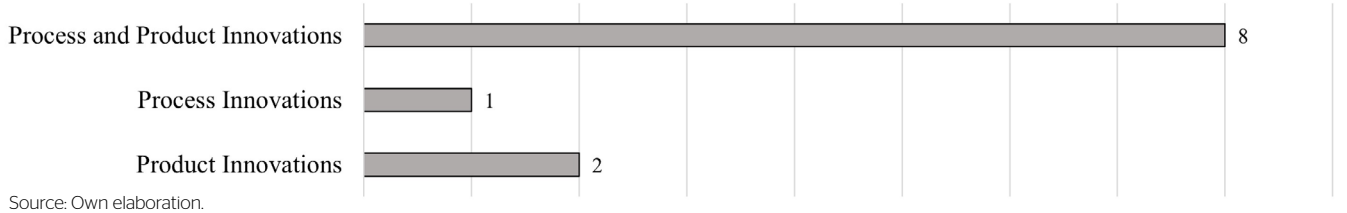
Regarding organizational and marketing innovations, it is possible to verify that CESBs place a greater emphasis on innovations in management techniques (84.6%), environmental management (61.5%), and external relations (53.8%) (Figure 4).

Other aspects, such as "aesthetics, design, or other changes" (23.1%), "marketing concepts/strategies" (38.5%), and "work organization" (38.5%), acquire less importance for CESBs. This result can be explained by the fact that water supply and sewage services have less differentiation both in terms of content and in the form of delivery to their customers. In addition, the respondent companies operate in a monopoly context and do not need to acquire more consumers beyond those who are circumscribed in their area of activity. Conversely, according to Pintec 2014 and 2017, in electricity and gas companies, environmental management techniques, management techniques, and work organization are more valued.

Innovative activities

The innovative activities are related to the existence of activities considered significant to support innovation by Pintec 2014 and 2017, which are the following:

- internal R&D activities;
- external acquisition of R&D;
- acquisition of other external knowledge;
- acquisition of software;
- acquisition of machinery and equipment;
- training;
- introduction of technological innovations in the market;
- other preparations for production and distribution.



Source: Own elaboration.

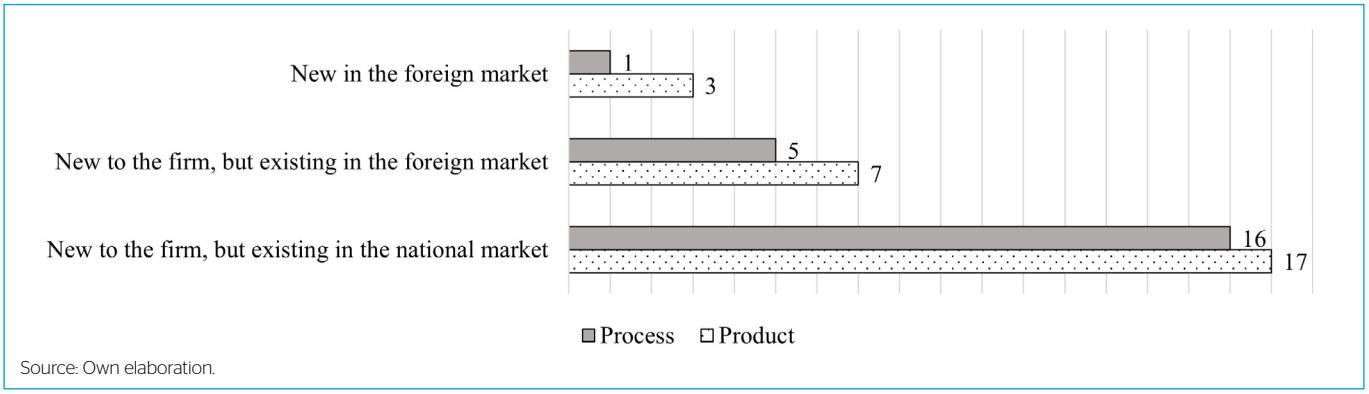
Figure 2 – CESBs that implemented product and/or process innovations.

Therefore, the CESBs were questioned about the level of importance given to innovation activities. Figure 5 shows the number of answers associated with the high and medium importance of these activities.

Among the activities considered as high and medium importance by CESBs are the acquisition of machinery and equipment (53.8%) and training (53.8%). Other important but less prominent activities are internal R&D activities (38.5%) and external R&D acquisition (30.8%). The remaining categories are classified as activities of low importance.

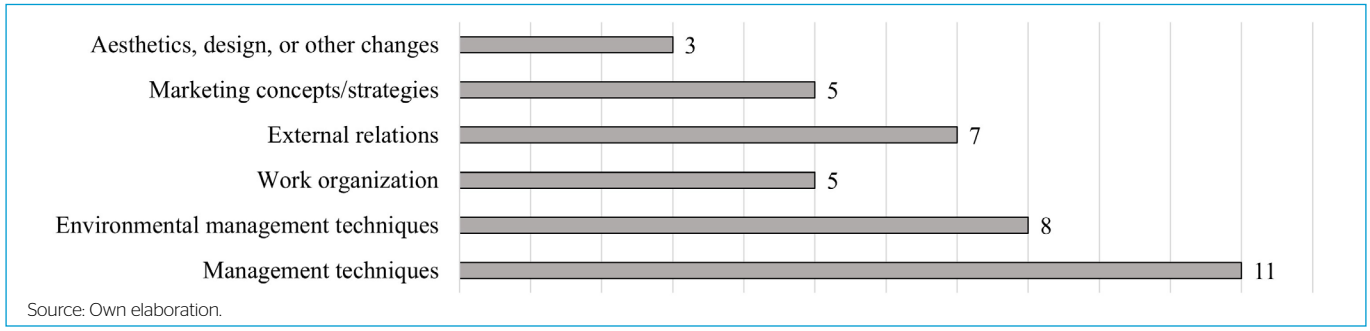
These results are different from those provided by Pintec 2014 and 2017, in which 72.5% and 63.4% of Brazilian electricity and gas companies, respectively, highlighted a high or medium importance of access to technological knowledge based on the incorporation of machines and equipment. In other public utility sectors studied by Pintec 2014 and 2017, the acquisition of machinery and equipment is of less importance – 65.7 and 46.7%, and the external acquisition of R&D (PINTEC, 2014, 65.1%; PINTEC, 2017, 76.6%) and software acquisition (PINTEC, 2014, 65.1%; PINTEC, 2017, 76.6%) are emphasized. This result is possibly due to the creation of regulations in both electricity sector – Brazilian Electricity Regulatory Agency (Agência Nacional de Energia Elétrica – ANEEL), law no. 9.991/2000 – and gas sector – Regulatory Agency for Sanitation and Energy of the State of São Paulo (Agência Reguladora de Saneamento e Energia do Estado de São Paulo – ARSESP) Ordinance CSPE no. 320/2004 – regarding the obligation of investments in R&D through projects with partners (universities, research centers, and companies), as well as the demonstration of a low tendency to automation of activities in the Brazilian basic sanitation sector.

Additonally, it is interesting to verify that internal R&D activities are considered important by 38.5% of CESBs, while for Brazilian companies this value is 17.5% and 18.3%, according to Pintec 2014 and 2017, respectively. These results suggest important implications for the basic sanitation sector. First, it reinforces



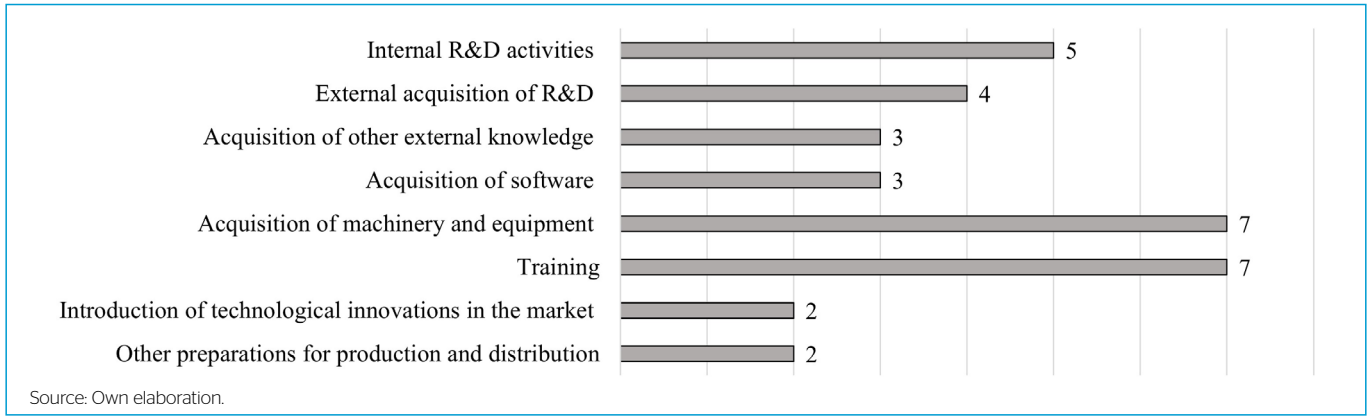
Source: Own elaboration.

Figure 3 – Degree of complexity of CESBs product and/or process innovation.



Source: Own elaboration.

Figure 4 – Organizational and marketing innovations at CESBs.



Source: Own elaboration.

Figure 5 – Importance attributed to innovative activities by CESBs.

the characteristic of *supplier-dominated* companies and, at the same time, draws attention to the low importance given to the acquisition of *software*, most likely due to the low degree of automation of the processes in CESBs.

Companies were also inquired about the periodicity with which they conducted innovative activities. Notably, 61.5% of CESBs affirmed that these activities are continuously executed, which is lower than the national average of 74.1% in 2014 and 80.1% in 2017. In electricity and gas, this percentage is even higher, reaching 90.5% and 86.7%, according to Pintec 2014 and 2017, respectively.

Sources of funding for innovative activities

In terms of the total value spent (in R$) on internal R&D activities in the period 2014–2016 by the companies analyzed, only five CESBs answered this question, and they stated heterogeneous values, ranging from 380,000 to 15,131,208 million reais. By comparing these expenses on internal R&D activities with the net revenue (VALOR ECONÔMICO, 2018) of the companies, the result shows that on average CESBs invest 0.28% of their net revenue. In Pintec 2014, the expenditure on internal R&D activities of innovative companies represented 2.54% of net sales revenue, while in electricity and gas companies the amount was 0.57%. In Pintec 2017, the percentages were, respectively, 1.95% and 0.66%.

In addition, 46.2% of CESBs affirmed that, between 2014 and 2016, they used government programs as funding sources to finance or support their innovative activities. This rate is higher than the national average of 40.0% and the electricity and gas sector 26.2% according to Pintec 2014 and 2017.

Figure 6 indicates the role of universities and research institutions to access non-refundable sources of funding and credit for innovative activities for CESBs. Partnering with these organizations creates fundraising opportunities. Additionally, it is important to highlight the role of the Funding Authority for Studies and Projects (FINEP), as the main source of funding for the CESBs RDI.

In our survey, when CESBs were further questioned about the general difficulties to implement their innovative activities, five (38.5%) CESBs claim not to face difficulties in the use of government programs and/or lines for financing or generally supporting innovative activities. In contrast, the companies mentioned difficulties, such as the complexity in filling out forms, the inadequacy of the accounting system, the need for financial counterpart, uncertainties of the legal framework, and minimum amount required for financing, which are all related to internal barriers to obtain financing.

In particular, the existence of sources of funding is an essential aspect of the innovation strategies within companies, given that investments in innovation are expensive and highly risky.

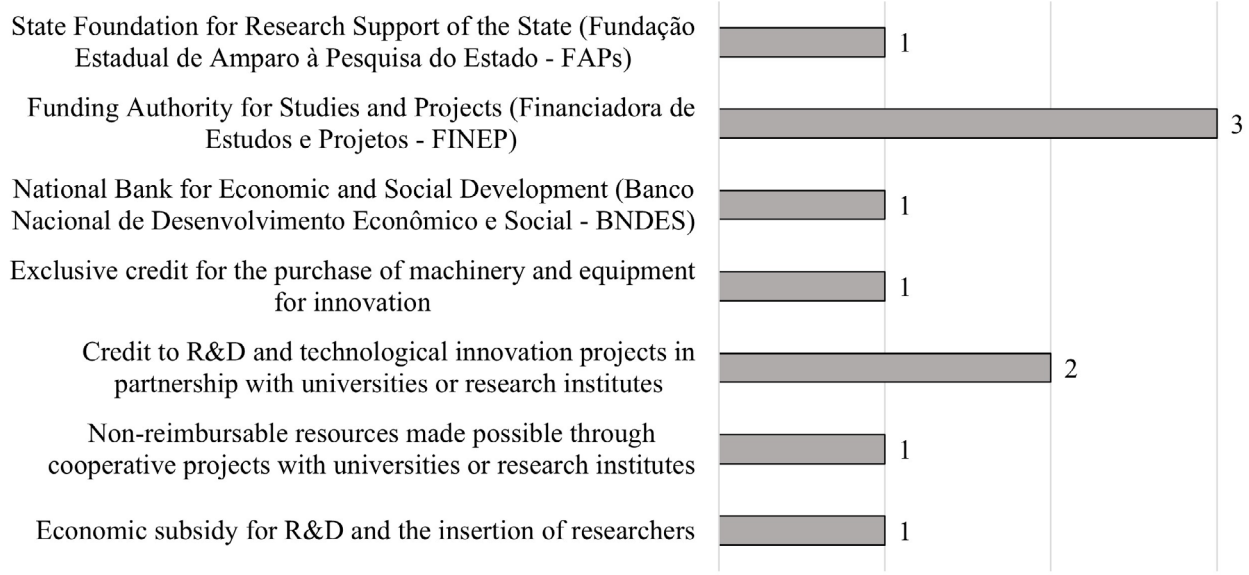
Cooperation for innovation

Cooperation is an important pillar in the companies' strategy for seeking external sources for the development of new technologies, products, and business. It is understood that partnerships are positive to support the reduction of technological costs, risks of development, and commercialization of new technologies, as well as promoting shared learning.

In this sense, eight (61.5%) CESBs affirmed that they were involved in cooperative arrangements to develop innovative activities between 2014 and 2016. This rate is higher than the national average of 40.0% (IBGE, 2016). It is also noteworthy that most of the CESBs partners are national, but are also verified international partnerships with suppliers, universities, and/or research institutes.

Figure 7 shows that among the main partner institutions of CESBs are the universities and research institutes, suppliers, other companies in the sector, and centers for professional training and technical assistance. Venditti and Pamplona (2020) also highlight this trend of partnership in their study.

Particularly in relation to the cooperation between universities and research institutions and basic sanitation companies, Furtado *et al.* (2008) verified that research conducted by these institutions has positive impacts on the establishment of technical parameters for products, processes, and quality standards, besides contributing to the dissemination of knowledge through publications of books and manuals, the creation of courses, elaboration of technological proposals, and installation of demonstration units. However, difficulties were found in



Source: Own elaboration.

Figure 6 – Sources of funding for innovative activities by CESBs.

transferring the generated new knowledge and technologies to the basic sanitation companies, due to technological misalignment, small scale of production of the technologies generated, due to the different local operating conditions.

From these results, it is verified that the status of *supplier dominated* is confirmed, because there is an emphasis on the relationships established with suppliers, although there is also an important role of universities and research institutes in this sense.

Intellectual property

Given the lack of responses regarding intellectual property obtained by the questionnaire applied to CESBs, the research investigated this aspect through the Questel Orbit database. The patents' indicator is traditionally used to measure innovation, and it is used as an proxy of the results of R&D activities of companies (SILVA; FURTADO, 2017). The collected data illustrated in Figure 8 distinguish the existence of an effort by the CESBs in the protection of intellectual property rights between the years 2000 and 2017.

In total, 19 patents were found during the analyzed period, and through the trend line in the figure, over time, the sum of the total amount of patents produced by CESBs has increased, which may be a consequence of an appreciation of the strategy of protection of intellectual property rights by these companies. Despite the low absolute numbers, Albuquerque (2000) highlights that when analyzing Brazilian patents, there is low involvement of companies in this patenting and a lack of continuity of research activities, due to low importance attributed to the management of the intellectual property. In this sense, it is likely that this same behavior may extend in the case of CESBs.

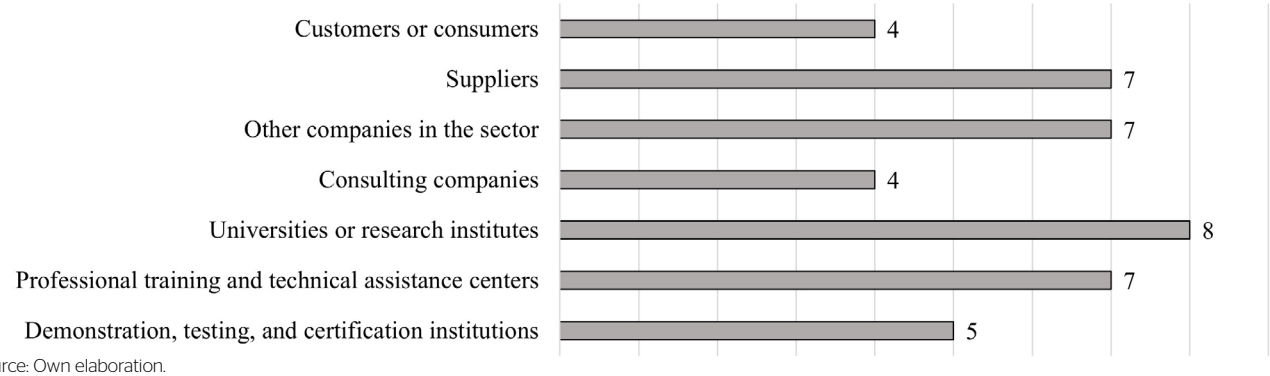
Impacts of innovations

Despite the limitation in forecasting the effects of actions conducted in the present, and distinguishing their impacts in the future, in our research we questioned CESBs about the expected impacts and the degree of importance of the main results when implementing the innovations. We used the results to proxy the importance level to of innovate innovation, given to the desired effects that guide CESBs (Figure 9). As a result, we verified that among those with a high degree of importance are the impacts in terms of cost reduction and improvement in the quality and capacity of the services delivered, contributing to increased profitability. Other impacts that have a medium degree of importance are reducing environmental impact, framing existing regulations, and health and safety aspects. Finally, impacts with marginal importance are those related to the opening of new markets, expansion of the range of goods and services offered, and expansion of the company's share in the market.

These latter motivations reinforce the influence of monopoly on these sectors and the reduced possibility of expanding their market. If the present study contemplated private sanitation companies, the results would possibly be different. Comparatively, the impact of the innovations expected by the CESBs is in line with the results obtained by the Pintec 2014 and 2017 in the electricity and gas sectors.

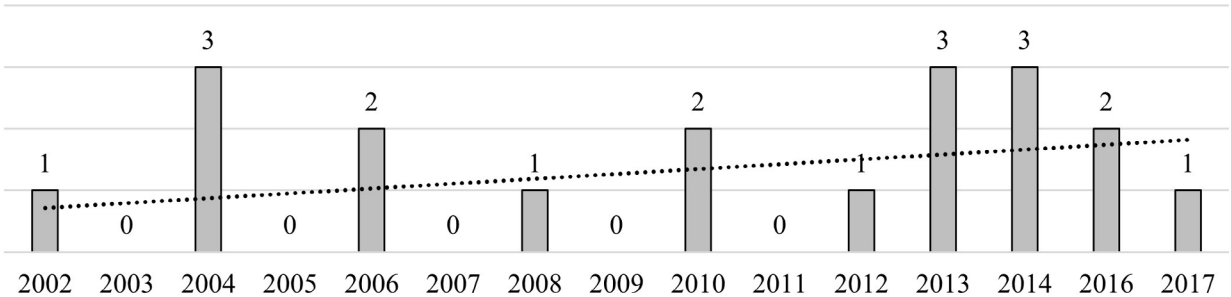
Organizational structure for innovation management

The organizational structure refers to departments and areas of the company that conducted innovation management activities, which are essential for the management and allocation of appropriate resources – structure, personnel,



Source: Own elaboration.

Figure 7 – Partners in the implementation of product and/or process innovations by CESBs.



Source: Own elaboration.

Figure 8 – CESBs' Patent Collection (2000–2017).

and capital – because if the innovative efforts occur in a poorly organized manner and with reduced resources, the chances of insufficient results are greater. Consequently, this organizational structure acquires its importance in view of the prospect that internal efforts for innovation achieve success.

To determine these aspects, CESBs were questioned about the existence of an area or department of innovation management in the company. Regarding this question, eight (69.2%) of the CESBs said they have such a structure, and five of these (76.9%) have their own staff dedicated to innovation activities. The impact of these structures is significant in the activities related to innovation because among the CESBs with a formal area dedicated to innovation management, five (66.67%) used RDI fundings, and seven (88.89%) used RDI cooperation activities. This demonstrates how these aspects are intrinsically related.

In total, the CESBs that participated in the research have 62 employees dedicated to innovation in companies. Of them, only 38.4% have an exclusive dedication to innovation management activities, and the rest have a partial dedication to R&D activities. This percentage is lower in the electricity and gas sectors, according to Pintec 2014 and 2017, in which only 13.8% and 14.4% of the companies' employees have exclusive dedication to R&D, respectively.

More specifically, when analyzing the employees, 46.7% of them have undergraduate degrees and 29.0% have master's and/or doctoral degrees. In the category with master's and/or doctoral degrees, most employees are exclusively dedicated and have master's degrees, which is higher than in the electricity and gas sectors. The Pintec 2014 data indicate that among people engaged in innovation activities in the electricity and gas sectors, 73.4% are undergraduates and 12.1% have master's and/or doctoral degrees (IBGE, 2016). According to the Pintec 2017 data, the number of people with an undergraduate degree decreased to 69.3% in comparison to the previous period, and the employees with master's and/or doctoral degrees increased to 17.0%, representing an increase in the qualification of these workers in these sectors, but lower than in the CESBs.

Innovation management system

In addition to the aspects enclosed by Pintec and the formal innovation management structure, the research also analyzed CESBs innovation management system, which is related to complex management processes in an environment of uncertainty, which is implemented to allow the success of the innovation activities.

In this sense, six (46.1%) CESBs have an innovation management system and three (23.1%) have a formal plan to guide the company's innovative activities. In consequence, only two (15.4%) CESBs conduct the selection and alignment of innovation projects to this plan. The research also analyzed the degree of development of certain innovation management processes (Figure 10).

In general, most of the processes have a low degree of development in CESBs. Nevertheless, there are processes with a medium degree of development, such as:

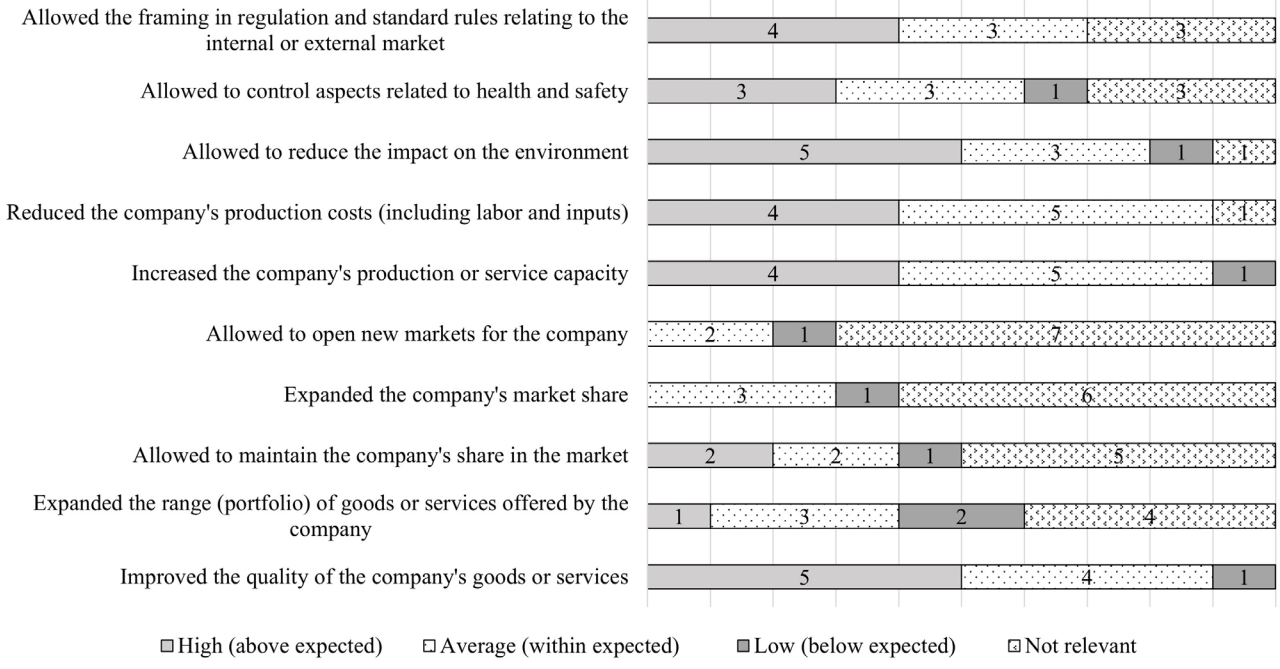
- "identification and prioritization of demands and opportunities for innovation";
- "management of partnerships for innovation and open innovation";
- "evaluation of the results and impacts of innovative activities"; and
- "management of intellectual property."

There is also a dual behavior of CESBs in relation to some processes, as in the case of "financing management of innovative activities." On the one hand, some of them denote this process with "zero" development; on the other hand, other CESBs place it as a process with high and medium development.

Barriers to innovation management

The final aspect investigated dealt with the barriers faced by the companies analyzed to conduct innovation management. Among the main barriers found by CESBs are:

- absence of innovation culture in the company;
- absence of the theme in the corporate strategy of the company; and



Source: Own elaboration.

Figure 9 – Importance of the impacts of the innovations implemented by CESBs.

- insufficient financial resources in the company to structure these activities (Figure 11).

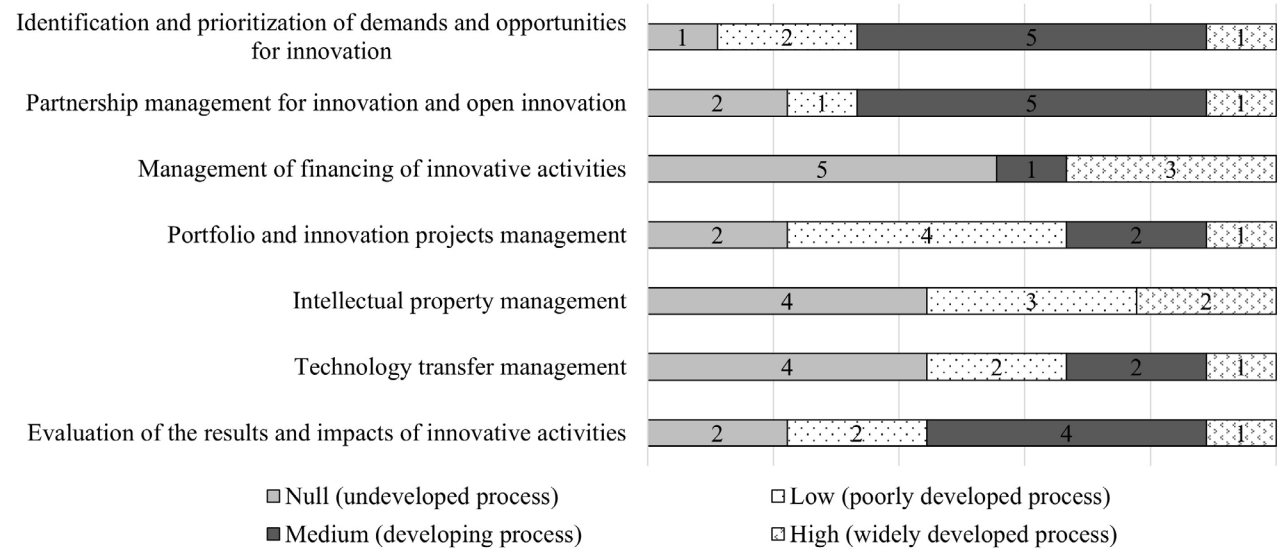
Given the results, although many CESBs possess structures and tools to support innovation, the non-inclusion of the RDI activities in the culture and strategy of the CEBSs also influences and limits its impact. Such results are in line with the limited allocation of human and financial resources in these activities. These aspects have a direct influence on other developments, such as the lack of use of funding sources, limited cooperation, low number of patents, and low degree of automation of companies.

CONCLUSIONS

Our study presents unprecedented contributions in terms of an overview of the innovation activities of Brazilian sanitation companies. First, the comparison of the CESBs with the other public utilities through Pintec 2014 and 2017 allows us to understand the differences and similarities in relation to the characteristics of their innovative dynamics. Therefore, despite the public utilities being understood by the literature as supplier-dominated, it also demonstrates their particularities.

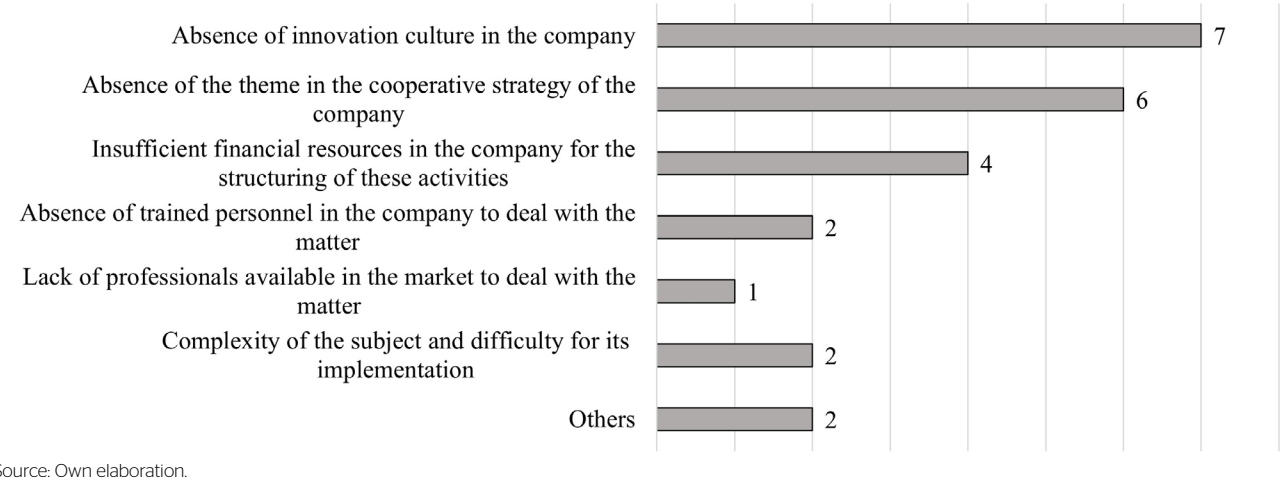
Additionally, although CESBs have structures and conduct actions in terms of RDI, their structures and activities are incipient due to the unprivileged place of innovation in the CESBs strategy, which simultaneously manifests itself in the absence of innovation culture in these companies. Therefore, innovation has a limited role in achieving company objectives in terms of universalization, mitigation of environmental impact, cost reduction, and the mechanism of catching up in relation to new trends (reuse, biogas production, creation of decentralized systems, among others).

These perspectives have implications for the strategies of sanitation companies and in the public policies formulated for the sector, because if the challenges



Source: Own elaboration.

Figure 10 – Degree of development of innovation management processes in CESBs*. *Three companies from our sample did not answer this question.



Source: Own elaboration.

Figure 11 – Barriers to structuring CESBs innovation management activities.

of the sector have solutions based on technological advances, large actions and investments will have to be performed internally by the companies to internalize new skills and actions in their service portfolio.

Nevertheless, this framework of low innovative dynamics is not exclusive to the basic sanitation sector. In other countries and public utility sectors, innovation has been fostered through regulations, which force companies to invest a share of their earnings in RDI activities. Recently, similar enforcement was implemented in Sabesp by ARSESP through the Ordinance no. 920/2019, which established the Program of Research and Technological Development for Innovation in Basic Sanitation Services, in which 0.05% of the Direct Required Revenue of Sabesp must be allocated in RDI activities.

Given this scenario, further research is needed to investigate the influences of these regulations on the innovative dynamics of basic sanitation companies, as has been happening in the electricity and piped gas sectors. In addition, it is considered desirable to expand the sample of basic sanitation companies to understand their structures and innovation activities, as the institutional environment and actors influence these activities.

AUTHORS' CONTRIBUTIONS

Ribeiro, B.C.: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Visualization, Writing – Original Draft, Writing – Review & Editing. Bin, A.: Conceptualization, Funding Acquisition, Investigation, Methodology, Supervision, Writing – Review & Editing. Serafim, M.P.: Conceptualization, Supervision, Writing – Review & Editing.

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