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Abstract

Purpose: In projected-based company, where all process dynamics and information flow are concentrated around projects, the role of the Project Management Office (PMO) becomes even more relevant. Precisely, the objective of the study was to highlight the importance of the PMO, as a tool in the management of organizational knowledge, in a research carried out, through a case study, in a project-based organization of the sanitation services sector.

Methodology: The qualitative research method used the Project Management Maturity Model (MMGP) to assess the level of maturity in project management and to identify organizational and knowledge problems observed in the phases of the knowledge management process, with the application of an electronic questionnaire to verify the perception of the directors regarding the role of the PMO in knowledge management, coding and personalization as knowledge management strategies and the 5W2H quality tool for planning actions.

Findings: The PMO's initiatives and practices in the organization under study resulted in an increase in the level of maturity in project management, in the total resolution of 70% of organizational problems and in the creation of a Knowledge Management System, confirming the relevant role of PMO in management organizational knowledge.

Unique contribution to theory, practice and policy*:* The research has as a differential the use of the PMO as an instrument for the organizational knowledge management, a theme that lacks in the literature, as well as the exploration of knowledge management in the sanitation services sector. Another contribution is the application of the Project Management Maturity Model to assess the level of project management maturity and identify organizational and knowledge problems and observe the improvement after actions.

Keywords: *Project-based Company, Project management Office, Knowledge management, Knowledge management system, Sanitary engineering design*

1. INTRODUCTION

Although very old in application, the discipline of project management (PM), as it is known today, began to receive special attention and greater formatting only in the final of 20st century. This rise is due to the incessant search for process optimization, which follows relentlessly companies in search of sustainability and growth, according to the survival parameters inherent to the capitalist system (Barcaui, 2012). Companies have been going through this process of continuous "design", where reality no longer includes projects conducted in an amateur way.

Faced with this scenario, the figure of the Project Management Office (PMO) gained prominence in this field of action and started to play a central role in the PM in almost all areas of human activity. The projects, due to their particular characteristics, they produce large volumes of knowledge. This factor implies that project-based organizations must be very concerned with knowledge management (Aubry, Richer, Lavoie-Tremblay, & Cyr, 2011), since the knowledge acquired in previous projects can be replicated in future projects, thus optimizing resources and obtaining a competitive advantage, for example.

Although, numerous works have pointed out the PMO as an invaluable resource for the exchange of knowledge in companies (Pemsel & Wiewiora, 2013) performing functions such as creating a repository of lessons learned (Dutton, Turner, & Lee-Kelley, 2014), innovation (Artto, Kulvik, Poskela, & Turkulainen, 2011), management of people and processes (Hobbs & Aubry, 2010), promotion of training, mentoring, workshops and seminars (Tshuma, Steyn, & Van Waveren, 2018), stimulation of formal and informal social interactions, elaboration of standards of projects and procedures (Paton & Andrew, 2019) and development and/or application of Information and Communication Technology (ICT) aimed at knowledge management (Desouza & Evaristo, 2006). These activities are carried out by the PMO according to the benefits expected by the organizations' internal clients (executive board, managers, employees).

The objective of the study was to highlight the importance of the PMO in knowledge management through the creation of a Knowledge Management System (KMS) covering the entire organization with a focus on structure, processes, people, technology and culture, with the PMO being responsible for implementation and operation of the system. The specific objectives were: to organize the physical and virtual structure; document project data, information and knowledge; train employees in management, technical and behavioral skills; and providing a knowledge-based learning culture.

The article is divided into five sections: literature review; research method; case study; results and discussion; and final considerations. The first section presents concepts from different perspectives of the PMO, knowledge management and the role of the PMO as an agent of knowledge. Next, the research method employed is exposed. Then the case study is presented in the projected organization of the sanitation services sector. In the

penultimate section, the results are published and their analyze are displayed. To conclude the article, but not the topic under discussion, final considerations are made and possible consequences of the study are indicated.

With the actions implemented by the PMO in the field of knowledge management, the following was achieved as a result of the study: the implementation and operation of a KMS by the PMO, which has a centralizing and integrating role. In addition to this result, an increase in the level of maturity in the company's project management was obtained, going from 1.16 to after 2.75, making a company more mature in this discipline; and the resolution of 70% of the organizational problems initially diagnosed. The directors' perception of the PMO's performance is consistent with the results obtained. Therefore, it was possible to highlight the importance of the PMO in knowledge management in the organization under study. The research's objective was reached and corroborated with the studies that have pointed out the PMO as a fundamental character in knowledge management.

2. LITERATURE REVIEW

2.1 Project management office

Much of the work done in organizations occurs as projects (Keil, Mixon, Saarinen, & Tuunainen, 1995). The Project Management Institute - PMI (2017) defines a project as a temporary effort undertaken to create a unique product, service or result. For Söderlund (2011), projects are temporary organizations, with an intentional death, purposely designed to provide benefits to a permanent organization or to certain stakeholders through complex problem solving processes. As such, project management has come to play a central role in managing organizations in almost all fields of human activity (Aubry, Hobbs, & Thuillier, 2008). In the midst of this scenario comes the figure of the Project Management Office, being better known for its acronym.

Unger, Gemünden and Aubry (2012) attributed the formation of PMOs to the challenges faced by project-based organizations in managing multiple projects as an integrated unit. In order to improve the performance of project management, we must implement the PMO within the organization (Bates, 1998; Julian, 2008; Ika, 2009; Spalek, 2012; and Jerbrant, 2013). Aubry *et al*. (2008) corroborate suggesting that a PMO is an essential aspect of project management in a corporate domain, because it aligns strategies, projects and structure.

The PMO concept emerged in the 1950s in the aerospace and defense industry (Darling & Whitty, 2016). The 1990s saw a rapid increase in the implementation of what at that time had become known as the PMO (Dai & Wells, 2004). In connection with the millennium bug (Y2K), there has been an exponential growth of PMOs in the IT sector to oversee the projects involved in the transition to the year 2000. Since then, many organizations have

implemented several PMOs for a variety of purposes at different levels in their organizational structures (Desouza & Evaristo, 2006). A study by Thomas and Mullaly (2008) found that, in the mid-2000s, the PMO had already become central to the use of project management in many companies.

In the literature, the PMO can be referenced by different titles: Project Office, Project Management Office, Center of Excellence (Dinsmore, 1999), Project Support Office (Hill, 2004), among other designations. Some deployments are verified even without any specific name, but performing work equivalent to that of the PMO (Barcaui, 2012). PMI (2017) defines PMO as a management structure that standardizes governance processes related to the project and facilitates the sharing of resources, methodologies, tools and techniques.

A PMO can also be called a Program Management Office, Project Management Office or Program Office. A PMO oversees the management of projects, programs, or a combination of the two. Regardless of the name, the PMO is the entity of the organization that provides a focal point for the discipline of project management (Rad & Levin, 2002). A PMO can be understood as a kind of "service provider" for the company, which has customers with specific needs.

PMOs vary in size, structure and responsibility (Desouza & Evaristo, 2006; Hobbs & Aubry, 2008; Hobbs, Aubry, & Thuillier, 2008). According to Patah and Carvalho (2009), a PMO is a structure that aims to connect a project and an organization as a whole. The PMO can also be defined as a formal layer of control between top management and project management within a project-based organization (Kerzner, 2003; Liu & Yetton, 2007). The PMO is considered an organizational entity charged with introduce practices and culture of project management within an organization (Desta, Root, & Diederichs, 2006).

The PMO facilitates the successful completion of the project management activity by providing risk and schedule specialists, tools, standards and best practice processes (Paton & Andrew, 2019). Among the functions performed by the PMO, it is possible to highlight: the development of skills and the project management methodology - includes activities in which the tools and methods are provided for those involved with the projects (Hobbs & Aubry, 2010). De Nadae, De Carvalho and Vieira (2015) point out as PMO's functions the creation and dissemination of a project management methodology that synthesizes the best practices.

According to Prado (2010), the functions of PMO are as follows: advising senior management and project managers, audit projects, engage with other sectors in order to increase the efficiency of processes, design and maintain methodologies, rules and standards, training project participants, guarantee the quality of the project, support for the creation of proposals, register and disseminate “best practices”, practice visual management, graphically represent the project development and the communication of the project controls. In addition, the PMO also provides administrative support for the project,

consultancy and mentoring in project management, in addition to organizing training in project management (Julian, 2008).

2.2 Knowledge management

The issue in focus of doing more with less implies reusing good practices, supporting innovative practices and preventing the reinvention of the wheel. This knowledge-based economy requires mechanisms for sharing knowledge (Aubry *et al*., 2011). Knowledge is a fluid mix of structured experience, values, contextual information and expertise that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of connoisseurs. In organizations, it is often embedded not only in documents or repositories, but also in routines, practices, processes and organizational standards (Davenport & Prusak, 1998). According to Sanz and OrtizMarcos (2019), knowledge is recognized as an essential asset to achieve an organization's strategic objectives. It is what differentiates an organization from its competitors.

It is difficult to identify where organizational knowledge resides. It can be understood as being in the minds of individuals, incorporated in the relationships between individuals and teams and in the formal and informal processes and routines of the organization (Swart, 2006; Turner & Lee-Kelley, 2013). De Nadae *et al*. (2015) add that knowledge is originated and applied in an individual's mind and in organizations, usually in the form of documents, files, organizational routines, processes, practices and rules. For this reason, knowledge must be well managed. According to Nonaka and Takeuchi (1995), there are two types of knowledge, tacit (implicit) and explicit knowledge. Tacit knowledge consists of experiences, mental models, beliefs and opinions. Explicit knowledge is a type of knowledge that can be easily defined and shared through information technology.

Knowledge management emerged in the academic world in the 1990s, becoming an especially relevant topic for companies (Frappaolo, 2002). Some of the most influential studies in this decade were those by Nonaka (1991, 1994), Nonaka and Takeuchi (1997), Davenport, Long and Beers (1998) and Hansen, Nohria and Tierney (1999). The knowledge management approach in organizations is characterized by the ability of a company to create knowledge as a corporate asset, to understand the need to manage it and to treat it with the same care as in the conquest of other tangible assets (Nonaka & Takeuchi, 1997).

Knowledge management can be defined as the effective learning processes associated with the exploration, exploitation and sharing of human knowledge (tacit and explicit) that use appropriate technology and cultural environments to enhance an organization's intellectual capital and performance (Jashapara, 2004). Knowledge management is the process by which organizations generate value from their experiences, intellectual and knowledge-based assets in terms of people's resources, documents and skills (AlMajed &

Mayhew, 2013). Knowledge management can be identified as the use of collective knowledge to increase the capacity for reaction and innovation and the reuse of experiences and practices. It consists of three basic elements: people, processes and technology (De Nadae *et al*., 2015).

The authors of one of the most cited studies Davenport *et al*. (1998) list the objectives of knowledge management as follows: reduce cycle time; reduce costs; obtain more efficient use/reuse of knowledge assets; increase functional efficiency; increase organizational adaptability; increase the value of existing products and services; and creating new knowledge-intensive products, processes and services. According to Randeree (2006), knowledge management essentially consists of processes and tools capable of capturing and sharing data. These processes can apply and share knowledge between individuals within an organization. De Nadae *et al*. (2015) teach that the design and dissemination of effective tools and processes to capture and share knowledge within an organization are the objectives of knowledge management.

Knowledge management occurs at all organizational levels: strategic, tactical and operational. At the strategic level, the focus may be on improving policies and practices; at the tactical level, the focus may be on monitoring the application of standards and methodologies; and, at the operational level, the emphasis may be on using existing knowledge to solve technical problems and acquiring new knowledge to refine procedures and expanding organizational know-how (Sanz & Ortiz-Marcos, 2019).

Some of the most influential studies on knowledge management (Nonaka, 1991, 1994; Nonaka & Takeuchi, 1997; Davenport *et al*., 1998; Hansen *et al*., 1999) adopt the strategic perspective, with a focus on knowledge management models. Magnier-Watanable and Senoo (2008) propose a model of knowledge management process composed of 4 phases: acquisition, storage, distribution and application of tacit and explicit knowledge. The phases of the knowledge management process, shown in Figure 1, are aligned with the phases of models for knowledge management described by other authors.

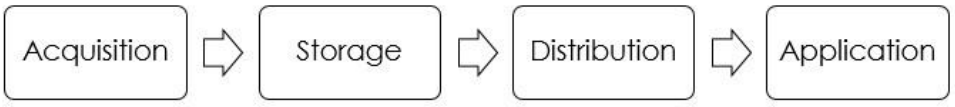

Figure 1: Knowledge management process. Source: Adapted from MagnierWatanable and Senoo (2008).

A knowledge transfer structure seeks to systematically structure the knowledge transfer elements, their relationships and the principles of how these elements interact. Knowledge transfer processes (create, store, share and use) and knowledge transfer infrastructure (people, tools, routines and systems) are the main elements that drive knowledge transfer in organizations. The general objective of knowledge transfer is to improve the systematic

interaction of infrastructure and knowledge transfer processes within an organization (Hobbs & Aubry, 2010).

The knowledge acquired must be available to authorized persons, so that the company develops organizational standards and norms to manage the acquired know-how. (Hamranova, Marsina, Molnar, & Okruhlica, 2014). When knowledge is stored, it becomes a resource that can produce competitive advantages, reduce labor, facilitate processes and reduce costs (Huang, Mohammed, Rowe, & Lai, 2011; Martensson, 2000). In some cases, knowledge sharing depends entirely on the individual and their social networks, and employees are generally not motivated to share their knowledge (Fong & Kwok, 2009). The failure of many knowledge transfer systems generally occurs as a result of cultural factors and not technologies (Ajmal & Koskinen, 2008).

2.3 PMO as a knowledge agent

The value of PMO in project management is already recognized by organizations and the scientific community. Despite playing roles in the Knowledge Management discipline since its inception, its role in this field is recent in the literature. Although recent, numerous studies have pointed out the PMO as an invaluable resource for the exchange of knowledge in companies (Pemsel & Wiewiora, 2013). In this area, PMO performes functions such as creating a repository of lessons learned, innovation, management of people and processes, providing training, mentoring, workshops and seminars, stimulate formal and informal social interactions, develop project and procedure standards and develop and/or apply Information and Communication Technology (ICT) aimed at knowledge management. Project-based organizations must be very concerned with knowledge management (Aubry *et al*., 2011), as they produce large volumes of knowledge. A large portion of this volume is in the form of lessons learned that according to Schindler and Eppler (2003) are defined as key experiences of projects that have a certain general relevance in the business for future projects. They went validated by a project team and represent a consensus on an important insight that should be considered in future projects.

Projects are sources of knowledge and are often considered efficient ways to combine knowledge and, thus, optimize the value of investments (Pemsel & Wiewiora, 2013). For organizations to obtain a competitive advantage, this knowledge needs to be effectively transferred between projects, as a result adding value to the business. Knowledge transfer between projects is therefore an important and decisive competitive factor for the organization (Tshuma *et al*., 2018).

Knowledge management is a critical aspect of project management because, by carrying out and managing the lessons learned from the projects, it makes it possible to favor and improve the current and future performance of the organization, as it helps organizational learning (Nonaka & Takeuchi, 1995; Davenport & Prusak, 1998). It is not a simple task to be performed, but because it is imbued with individuals as tacit knowledge,

it is conceived through the appropriation and systematic recording of the project's history (Rosa, Chaves, Oliveira, & Pedron 2016; Swain & Lightfoot, 2016).

Sanz and Ortiz-Marcos (2019) indicate that knowledge management is often carried out by PMOs. Desouza and Evaristo (2006) add that PMOs were originally conceived as a means of capturing and disseminating good project management practices and project knowledge across the organization. Effective management of knowledge transfer increases project performance (Louw, Steyn, & Van Waveren, 2017) and PMOs play a supporting (moderator) and facilitator (mediator) role in the transfer of knowledge between projects (Tshuma *et al*., 2018; PMI, 2017; Julian, 2008; Hobbs & Aubry, 2007). In addition, Tshuma *et al*. (2018) point out that PMOs mitigate the risk of losing knowledge of the project due to team time constraints. The PMO can provide continuity between the phases of the project life cycle, maintaining the coherence of purpose, process and method and integrity of knowledge (Paton & Andrew, 2019).

The integrating role of PMOs serves, among other things, as a context for achieving knowledge goals for the organization (Pemsel, Wiewiora, & Brown, 2014). Given this integrating capacity of the PMO, Artto *et al*. (2011) found that the PMO is focusing on the innovation front end. The PMO also plays a central role in organizing project management practice communities (Aubry *et al*., 2011) and in fostering project managers' networks and knowledge flows (Müller, Glückler, & Aubry, 2013; Pemsel & Wiewiora, 2013).

Tshuma *et al*. (2018) argue that without a formalized structure such as a PMO that focuses both on the short term (project efficiency, impact on the project team and the client (Shenhar, Dvir, Levy, & Maltz, 2001) and on the long term (project alignment and organization strategy, preparing for the future and business success (Artto *et al*., 2011)), the objectives of the success of the project portfolio, effective and efficient transfer of project knowledge can be very difficult to achieve. Thus, from an organizational point of view, the PMO appears to complement the learning mechanisms that try to mitigate these opposing characteristics between projects and companies (De Nadae *et al*., 2015).

De Nadae *et al*. (2015) point out that the benefits of knowledge management by the PMO are apparent. Among the benefits is the improvement of the decision-making process, the result of the greater involvement of the team. The answers to problems that arise during the execution of the project materialize more quickly, reducing rework and improving productivity. Consequently, the relationship between employees improves and increases the efficiency of teamwork.

Desouza and Evaristo (2006) separate the functions of PMOs at three levels: strategic, tactical and operational, and point out that knowledge management remains one of the main functions of PMO at all levels, which is also observed in other works (Rad & Levin, 2002; Pemsel & Wiewiora, 2013). In addition, the PMO requires skills to manage different areas and types of knowledge (Julian, 2008) and in relation to specific project knowledge, such as technical, procedural and organizational.

In relation to organizational learning, PMOs act in the registration and maintenance of project knowledge, holding lessons learned workshops with the teams to increase their knowledge repository and use documented experiences in future projects in the organization (Desouza & Evaristo, 2006; Liu & Yetton, 2007; Julian, 2008; Hobbs & Aubry, 2010; Pemsel & Wiewiora, 2013; Dutton et al., 2014; De Nadae et al., 2015; Tshuma et al., 2018).

PMOs play a coordinating role (allocating resources between projects, transferring tacit knowledge from the team members themselves or through the appointment of other knowledge holders), control (establishing and maintaining a solid knowledge base) and support (cultivating project management standards, improving knowledge transfer between projects and communication) in the knowledge transfer structure (Unger *et al*., 2012; Dutton *et al*., 2014; Tshuma *et al*., 2018). However, PMOs must guard against knowledge overload and focus on the dissemination of knowledge that will add value to projects and the organization, incorporating knowledge into the project workflow, process, template and / or specification (Bell, Van Waveren, & Steyn, 2016).

Aubry *et al*. (2011) observe in large organizations the creation of PMO communities designed to learn and share knowledge in project management. Pemsel and Wiewiora (2013) highlight the contribution of PMOs in the perception of how project managers share knowledge and awareness about the need to structure PMOs to align with the nature, needs and expectations of project managers in order to improve knowledge sharing in organizations.

Müller *et al*. (2013) suggest that new knowledge to be developed within the PMO requires exchanges between members of the PMO, which seems to occur more in formal meetings than in day-to-day work. Walker and Christenson (2005) state that PMOs can promote individual and group learning by providing a knowledge network structure that enhances knowledge sharing, sharing specialized knowledge and insights at the individual, group and organizational levels.

PMOs assist in selecting the appropriate transfer mechanisms for the successful dissemination of project knowledge (Simonin, 1999). This performance is repeated according to Tshuma *et al*. (2018) who report that PMOs play an important role in the management of ICTs to ensure that effective transfer mechanisms are implemented and used to influence the characteristics of the knowledge generated and the knowledge used. Regardless of the PMO's roles in relation to knowledge management, it seems clear that it is necessary to coordinate knowledge processes and results at each level and across the organization, as there is empirical evidence that knowledge management affects business value through knowledge alignment (Costa & Rezende, 2018).

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3. RESEARCH METHOD

This research, qualitative in nature, was based on a case study of the PMO's performance in relation to knowledge management in a project-based company in the sanitation sector headquartered in southern Brazil. The period of the referred study lasted for 4 years, starting in 2015 and ending in 2019. In order to verify the current and future status, an application by the PMO of diagnosis was established throughout the organization to assess the level of maturity in PM. The diagnosis provides, in addition to checking the level of maturity, the perception of organizational and knowledge problems.

The model chosen to carry out the company's evaluation was the *Modelo de Maturidade em Gerenciamento de Projetos* – MMGP, Project Management Maturity Model, by Prado (2010). The choice of the model had as criteria the cost, relevance in the use and the recommendation of specialists. The model, launched in 2002 and updated in 2014 in its second version, proposes to assess maturity through a 40-question questionnaire. This model has been used, since 2005, in a maturity research conducted in Brazil and other countries.

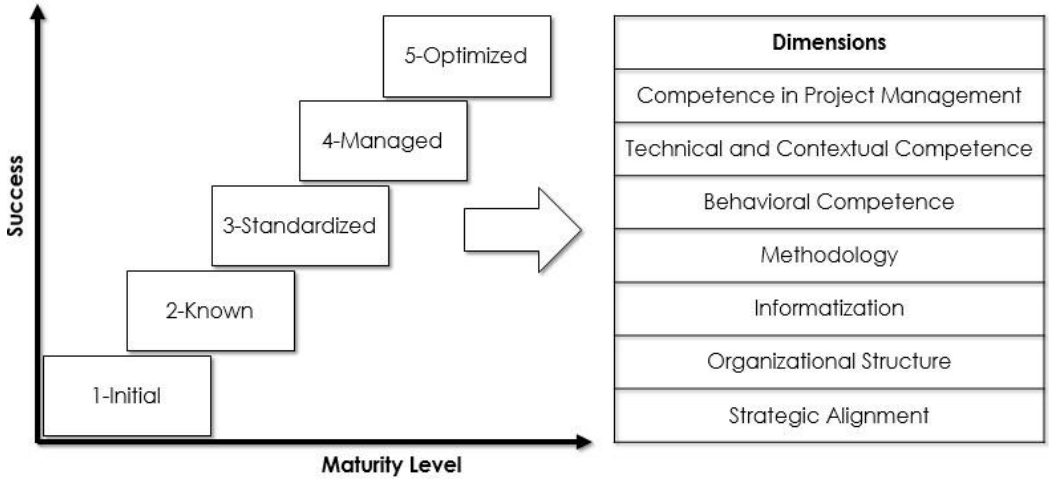

Figure 2: Maturity levels of the MMGP model. Source: Adapted from http://www.maturityresearch.com (2015).

This model includes 5 levels (1-initial, 2-known, 3-standardized, 4-managed and 5optimized) where each level can contain up to 7 dimensions of maturity in different intensities and peculiarities. The dimensions are: Skills in PM, technical and contextual, behavioral; Methodology; Informatization; Organizational structure and strategic alignment. The model considers processes, tools, people, structures and strategies and adheres to PMBOK (PMI, 2017), ICB (IPMA, 2018) and Prince2 (Axelos, 2017).

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To assess whether the result of the applied model was consistent with the perception of the two directors of the organization, a questionnaire was prepared containing five questions addressing the role of the PMO in processes of knowledge management, training, tools, standards and organizational culture. The responses were structured in a multiple choice format using the Likert scale, containing five alternatives, ranging from "strongly disagree" to "strongly agree". The questionnaire was prepared using the web-based tool Google Forms® and its responses were automatically linked to an electronic spreadsheet. For the collection of responses, a link to the electronic form was sent to the two directors.

Two strategies for knowledge management in the organization were adopted, codification and personalization, proposed by Hansen *et al*. (1999) for consulting companies and also referenced by Kasvi, Vartiainen and Hailikari (2003). These strategies can be related to different ways of spreading knowledge. The coding strategy involves coding knowledge and storing it in databases that can be accessed and used by any employee. In the personalization approach, knowledge is strongly related to the person who developed it and is shared mainly through person-to-person contacts. Figure 3 shows the knowledge management strategy adopted in the company.

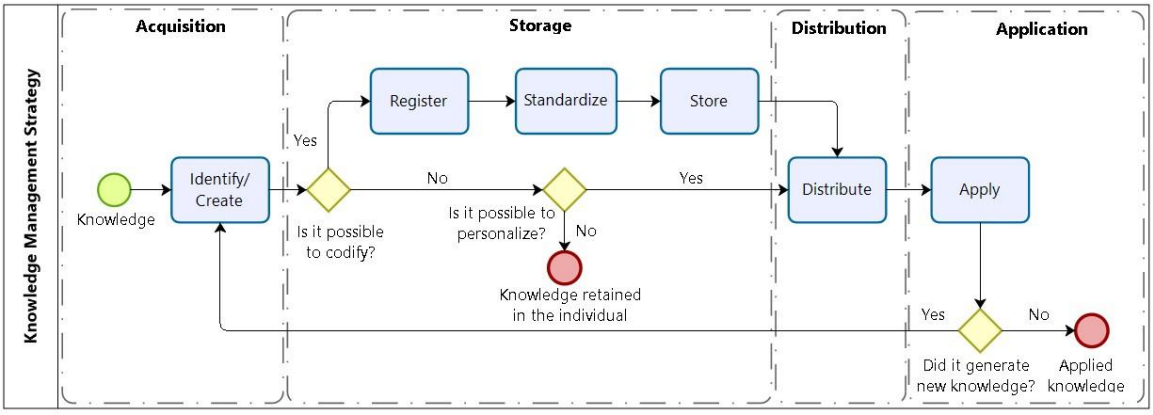

Figure 3: Knowledge Management Strategy. Source: Authors (2015).

To plan the actions, the 5W2H quality tool was used by PMO in order to make the planning and execution much clearer and more effective. Appeared in Japan in the automobile industry, it aims to facilitate the planning of any activity to achieve improvements within companies. The term is formed by the initials, in English, of seven keywords for the development of the method (Table 1): what, why, where, when, who, how and how much.

Table 1: Representation of the 5W2H Tool.

What	Why	Where	When	Who	How	How much
Action	Justification	Place	Time	Responsible	Procedure	Cost

Source: Authors (2015).

4. CASE STUDY

4.1 Organizational context

Founded in 1980, the company based in the south of Brazil is a service provider focused on the development of engineering design studies and projects in the Sanitation area, with operations in several states in the country and abroad, whose clients are mostly public and private concessionaires of water and sewage services. The company has a project-based organizational structure and has a staff of 30 employees composed of engineers, designers, technicians and administrative assistant. The company has an annual portfolio of 15 to 20 projects with an average duration of 6 months to 1 year and fits into a Small Business Size (SBS), according to its Annual Gross Operating Revenue.

The main challenge of the organization is related to the application of good PM practices in order to achieve success in its projects, which consists of meeting the triple constraint: scope, time and cost. In this sense, the discipline of Knowledge Management has a lot to contribute to this process. Therefore, in July 2015, the PMO was implemented, with the objective of increasing the level of maturity in the organization's PM and improving organizational processes.

4.2 Diagnosis of the project management maturity level

In 2015 the MMGP model was applied and the result was 1.16 of the maturity level in PM (Figure 4). The low level of maturity in PM reinforced the introductory level in PM in which the company was. The scenario becomes even clearer when observing the company's adherence to the dimensions of maturity (Figure 5).

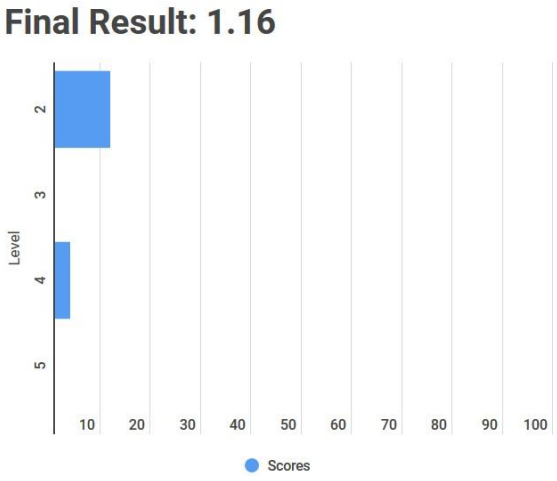

Figure 4: MMGP Result - Year 2015. Source: Adapted from MMGP Model (2015).

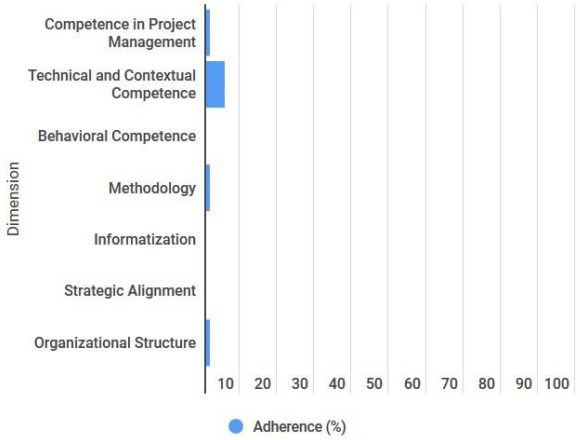

Figure 5: Adherence to Dimensions - Year 2015. Source: Adapted from MMGP Model (2015).

These results directly reflected the lack of professional competence in the PM field, the lack of standardization of documents and processes, the absence of adequate methodology, the lack of tools to support management and information, the need for training the team in hard skills and soft skills, an organizational structure and culture that did not favor knowledge management.

4.3 Organizational problems

The main organizational problems identified (Table 2) by the PMO through the diagnosis are related to the management style and history of the organization. Historically, managers have prioritized technical knowledge because their knowledge was strictly technical. As a result of that, managerial aspects relevant to the organizational learning process was neglected.

Table 2: Organizational Problems Identified. Source: Authors (2015).

#	Organizational Problems
1	Incorrect perception of what projects and project management are
2	Projects executed on the basis of intuition, “goodwill” or “best effort” individual
3	Absence of planning and control
4	Lack of standardized procedures
5	Projects without contracts, with great informality in the project initiation stage
6	Decentralization in file storage and consequent overlap and rework
7	Internal communication
8	Quality of delivery of the final product
9	Lack of organization management
10	Poor distribution of tasks

Source: Authors (2015).

4.4 Knowledge problems

Considering the knowledge management process model proposed by MagnierWatanable and Senoo (2008) composed of 4 phases (acquisition, storage, distribution and application), problems were observed in the 4 phases of this process in the company under study. It is worth noting that problems observed at a certain stage of the process may be due to the absence or failure in previous stages. In the acquisition phase, where knowledge is identified and created, there was only the creation of expertise, remaining as tacit knowledge for each employee, and the creation of project documents, explicit knowledge. There was an absence of a culture that fostered the creative process and an environment of continuous learning, with only specific initiatives.

The storage phase was neglected either due to the absence or the inadequate way of physical and digital storage of knowledge (documents without standards, without organized filing, isolated files on desktops or in places with restricted access). There was no record in the company's organizational assets forms of knowledge such as lessons learned,

standardized documents, rules and procedures. This stage of the organizational memory formation process has been neglected over the company's 35 years of history.

In the distribution phase, it was carried out informally, from tacit to tacit knowledge and subject to the employee's interest in sharing. There was only the sharing of expertise, through interaction between employees. There was no procedure, channel or person responsible for the process or a culture that would allow sharing in the company. The application of knowledge was restricted only to the employee who held the knowledge and applied it to the projects in which s/he was located or using documents prepared by other employees. Due to this scenario, many employees faced the same problems and difficulties, experiencing the well-known expression “reinvention of the wheel”.

4.5 Initiatives and practices

Using the 5W2H tool, 22 actions necessary for the creation of the KMS were listed. The actions were established mainly due to the absence or failure of existing processes, training and lack of structuring and organization of the company's intellectual capital. The planned actions were in the physical structure (meeting room, lockers, books and documents), virtual (server, files and e-mail) and in the company's culture. The calendar of actions was established for 4 years of PMO activity.

A large part of the actions were held to the PMO and some with the participation of employees and the Information Technology (IT) sector. The planned procedures were bibliographic review, benchmarking, filing techniques, meetings, training, use of available software (word®, excel®, powerpoint®, bizagi®, google forms®) and acquired (MS Project® and Runrun.it®). The costs established were in hours worked by those involved and in infrastructure (server, software licenses, cabinets and office supplies).

Within the scope of Organization Management, a server was initially deployed with the assistance of the IT sector. It served to centralize the entire database, information and knowledge of the organization, perform periodic backup and provide network access to employees. Before the migration of all material available on the employees' computers, the PMO structured the directories to organize and facilitate accessibility. The physical documents of the projects previously released in folders were organized and archived by contract in folders with codes and stored in a new cabinet.

The entire bibliographic collection, previously in a restricted access location, was cataloged and stored in a new easy-to-access cabinet with an electronic catalog available on the server. The PMO was responsible for keeping both the physical and virtual files organized and updated. The mapping of the company's processes was started to create the process book, but it was not completed due to difficulties in prioritizing activities and culture.

In the field of People Management, a Competency Management System was developed. Initially, a database was built containing information from employees such as age, time in the company, sector, level of education, mastery of languages, knowledge in design, dimensioning and management softwares, experiences in projects divided by themes, management experience, project affinities, among other information. This database is updated every six months through an online form made available to employees.

A histogram of resources was created for planning and allocating employees according to the database created (specialties and affinities) and availability, updated bimonthly by the PMO in a meeting with the executive board and project managers. Based on the company's database and needs, an annual training calendar was created on management, technical and behavioral topics, with two per month, where the PMO is the coordinator and the instructors are the specialists in each topic. After the training, an evaluation of the training and the course material made available on the server are carried out.

For the management of activities and historical record (scope, involved and time) the web-based software Runrun.it® was implemented, which remained until 2017, a year of change in the work dynamics in the organization. Feedback was another practice implemented by the PMO that has become part of the culture and is applied by managers and the PMO itself to employees at the end of project stages, specific cases and when a professional is dismissed.

In the field of the PM, a flexible methodology was elaborated according to the size of the projects (complexity and duration) and from it standards developed were used by the project managers for the initiation, planning, execution, monitoring and closing of the projects. For the lessons learned, a register bank was created containing information about the project, manager, knowledge area, what went wrong, causes, solution found, how to avoid it, what went right, how to replicate and the action plan. The lessons are collected by the project managers in follow-up and project closing meetings through the Closing Term and are recorded in the database and disseminated by the PMO.

From all standardization and organization a Project Management Information System (PMIS) was created in excel operated by the PMO containing the main information of each project as technical responsible, sponsor, manager, contractual and management documents and status. The promotion of the PM culture is through the training previously mentioned, through the weekly sharing of short videos (5 to 10 minutes) on various subjects taught by project management specialists available for free on the web and through informal conversations.

5. CASE STUDY

In 2019, a new assessment of the level of maturity in the PM was carried out, using the same MMGP model, where an increase in the level of maturity in the company's PM was

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observed from 1.16 to 2.75. The result (Figure 6) after about 4 years of implementation and operation of the PMO shows that there has been a significant advance due to actions implemented by the PMO in the field of knowledge management. This is evident when observing the evolution of the company's adherence to dimensions (Figure 7).

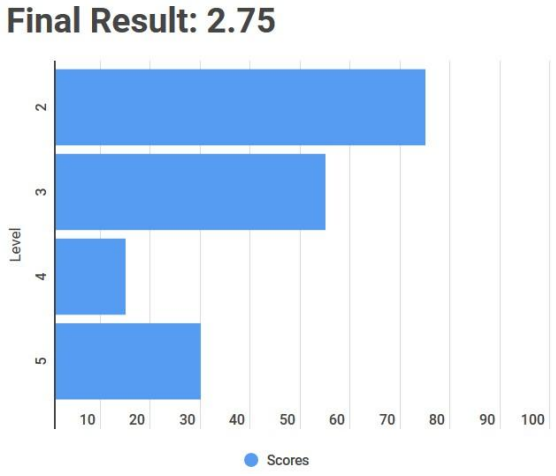


Figure 6: MMGP Result - Year 2019. Source: Adapted from MMGP Model (2019).

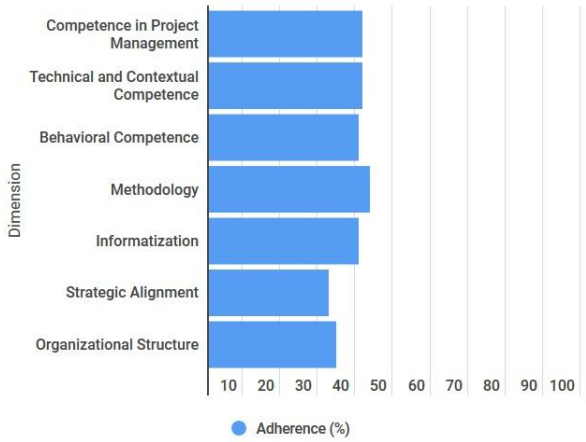
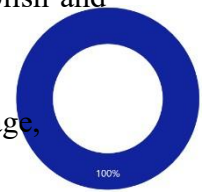
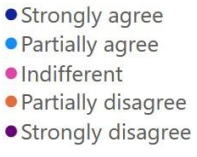
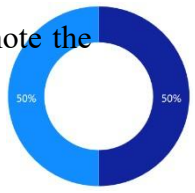
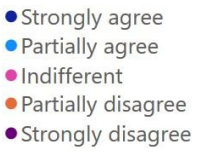
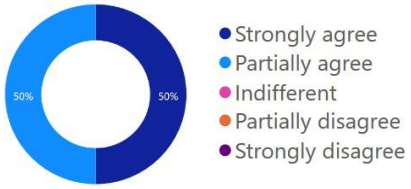


Figure 7: Adherence to Dimensions - Year 2019. Source: MMGP Adapted from Model (2019).

The results of the MMGP model were consistent with the perception of the two directors of the company as observed in the responses to questions about the performance of the PMO during the study period.

Table 3: Perception of the Directors in relation to the PMO's Performance in Knowledge Management.

#	Question	Answer	Legend
1	Did the PMO during its period of operation establish and maintain adequate processes for knowledge management (creation, storage, sharing and use) in the organization?		
	During its period of operation, did the PMO promote the training of employees in hard skills		

2	(technical skills) and soft skills (behavioral skills) through training and seminars that provided the use and creation of new knowledge to projects?	
3	Were systems and/ or tools implemented by the PMO during its performance period that contributed to the knowledge management processes?	
4	Did the PMO during its period of operation establish routines, methodologies and templates that contributed to the development of the projects?	
5	During its period of activity, the PMO fostered a culture of knowledge -based learning by creating an environment of trust that favored sharing?	

Authors (2020).

Regarding organizational problems, 70% initially mentioned were resolved in their entirety, except for the lack of standardized procedures, the absence of planning and control and the lack of internal communication that were partially resolved, representing 30%, as shown in Figure 8 .

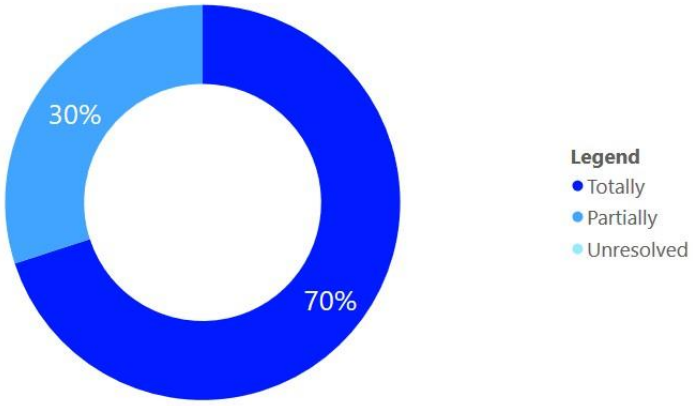


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Figure 8: Organizational Problem Resolution Rates. Source: Authors (2019).

Based on the performance of the established actions, it was possible to meet the specific objectives and create the KMS for the organization (Figure 9), with the stakeholders mainly responsible for the identification, creation and use and the PMO, in addition to these, for standardizing, organizing, storing, review and share knowledge.

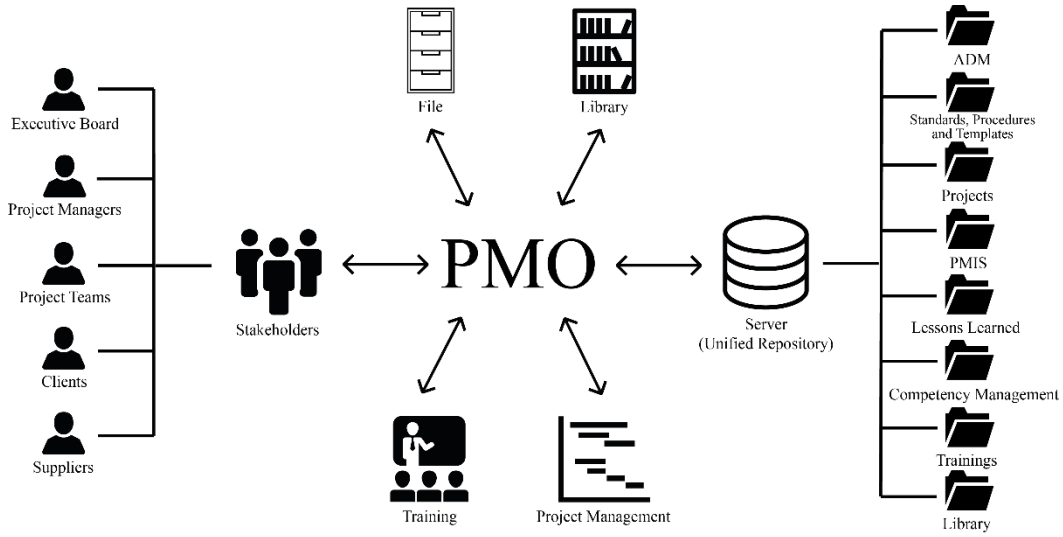

Figure 9: Organization's Knowledge Management System. Source: Authors (2019).

From the implementation and operation of the KMS was confirmed the role that PMOs play as support (moderator) and facilitator (mediator) in the transfer of knowledge between projects, between the project and executive directors, encourager of the project management culture and knowledge sharing, provider of training and norms, procedures and standards as pointed out by authors (Tshuma *et al.*, 2018; PMI, 2017; De Nadae *et al.*, 2015; Pemsel & Wiewiora, 2013; Julian, 2008; Hobbs & Aubry, 2007; Desouza & Evaristo, 2006; Rad & Levin, 2002) resulting in a focal point of knowledge in the organization.

The next section presents the conclusions, recommendations and the possible ramifications of this research.

6. FINAL CONSIDERATIONS

The support of sponsors, in this case of the executive board, as well as influencers in the company for the implementation of knowledge management practices is a critical success factor. This finding is in line with the work of Davenport *et al*. (1998) and Aubry *et al*. (2008). The change in the way of working, automating or introducing a new culture clashes with the organizational culture of the company in which employees are accustomed,

which creates great difficulty in the implementation in the absence of support from the actors mentioned above. The PMO must ensure sponsor support and provide a culture of knowledge management across the company.

Lessons learned are actually learned only if they are acquired, stored, disseminated and used by the team. In this case, we can effectively call them lessons learned, otherwise they are lessons to be learned. The greatest difficulties encountered were during registration and dissemination. In the first case, people were afraid to register their failures and be judged or reprimanded. In the second situation, despite the storage of lessons to be learned, few people accessed the database. For both cases, a more intense role of the PMO is recommended in exposing the benefits that good practices from the lessons learned can provide to the individual and organization. This recommendation is consistent with the study by Schindler and Eppler (2003).

The mapping of processes in the company was partially carried out for a number of reasons: dispute between the mapping activity and the professional's job functions; employees' fear of being fired, once their processes are mapped; thought of who holds the knowledge has the power. Intensive work by the PMO with stakeholders is recommended. It concerns showing the benefits of mapping, as well as the support of sponsors and the creation of an organizational culture of collaboration, learning and trust, in agreement with the work of Tshuma *et al*. (2018).

Knowledge management is indispensable in organizations due to the existence of knowledge in the company, in the people and in the processes carried out. All of these elements are fundamental to the creation of organizational memory. Using knowledge management, a company can reduce the costs of its products and invest in intellectual capital, having a better cost-benefit ratio, as indicated by Davenport *et al*. (1998). Knowledge that is not registered, shared and applied to the company's problems does not add value to the company.

The improvement in project management skills, technical and contextual, as well as behavioral contributed to change the organizational culture. This change was an important factor that had an influence on the sharing of knowledge among the employees of the company under study. This conclusion is in line with the studies by Dutton et al. (2014) and De Nadae *et al*. (2015) who claim that organizational culture is the main factor influencing the knowledge sharing process.

The necessary profile for professionals working in the PMO with regard to technical, behavioral and contextual competences proved to be important in the performance of the knowledge management discipline. Regardless of whether the person responsible for the theme in the company is part of the PMO team or not, it is essential that s/he has common skills of project managers, especially organization, communication, teamwork, creativity, transparency and, above all, leadership as observed in the studies by Kasvi *et al*. (2003),

Julian (2008), Müller and Turner (2010), Fisher (2011) and Chen, Fu, Liu, Xu, Zhou and Liu (2019).

The results of the study showed that the PMO can be an excellent tool for knowledge management in the organization, as other works have already highlighted (Aubry *et al*., 2011; De Nadae *et al*., 2015; Desouza & Evaristo, 2006; Dutton *et al*., 2014; Hobbs & Aubry, 2007; Hobbs & Aubry, 2010; Julian, 2008; Liu & Yetton, 2007; Müller *et al*., 2013; Paton & Andrew, 2019; Pemsel & Wiewiora, 2013; Pemsel *et al*., 2014; Rad & Levin, 2002; Sanz & Ortiz-Marcos, 2019; Simonin, 1999; Tshuma *et al*., 2018; Unger *et al*., 2012; Walker & Christenson, 2005).

Among the possible ramification of this research, we can highlight: the development of a methodology for the implementation of a Knowledge Management System in projectbased organizations; the verification of the PMO functions that most contribute to knowledge management; the correlation between maturity in project management and knowledge management; and what skills are required by PMO members to be able to act in knowledge management.

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