

A KNOWLEDGE TAXONOMY IN THE CONTEXT OF ORGANIZATIONAL ROUTINES: AN STUDY IN A PUBLIC UNIVERSITY

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ABSTRACT: Knowledge is one of the most important assets in organizations. While there are several studies about knowledge management, there are few texts dedicated to classifying the existing types of knowledge in the organizational context. As such, the concept of knowledge is still overlooked in the organizational literature. Hence, this situation poses a dilemma: how could a thing that is not well understood to be adequately managed? Drawing on current knowledge taxonomies and the organizational routines concept, we address this gap by outlining a taxonomy of how knowledge manifests in the execution and structuration of organizational routines. This taxonomy is generated through the grounding process of examining the organizational routines of an academic department in a public university. As the main result, there are proposed four basic types of knowledge: *stable-reproducible*, *problem-solving*, *incremental-shift*, and *paradigmatic-shift*. As the main theoretical contribution, this paper introduces a knowledge taxonomy, which is an alternative view of the current taxonomies. As a practical implication, these four types of knowledge presented suggests the necessity of the development of specific knowledge management practices for each type of knowledge.

Keywords: grounded theory. knowledge taxonomy. knowledge management. knowledge classification. organizational routines.

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UMA TAXONOMIA DO CONHECIMENTO NO CONTEXTO DAS ROTINAS ORGANIZACIONAIS: UM ESTUDO EM UMA UNIVERSIDADE PÚBLICA

RESUMO: O conhecimento é um dos mais importantes ativos nas organizações. Enquanto existem vários estudos sobre gestão do conhecimento, poucos textos são dedicados a classificar os tipos de conhecimentos existentes no contexto organizacional. Não obstante, o conceito de conhecimento é ainda negligenciado na literatura organizacional. Portanto, esta situação apresenta ainda um dilema: como poderia algo que não é bem compreendido ser adequadamente gerenciado? Baseado nas existentes taxonomias do conhecimento e no conceito de rotinas organizacionais, nós abordamos esta lacuna apresentando uma taxonomia sobre como o conhecimento se manifesta na execução e estruturação das rotinas organizacionais. Esta taxonomia é gerada a partir do método *ground theory*, por meio do exame das rotinas organizacionais de um departamento acadêmico de uma pública universidade. Como principal resultado foram identificados quatro tipos básicos de conhecimento: *reproduzido de maneira estável, solução de problemas, mudança incremental, mudança paradigmática*. Como principal contribuição teórica este artigo introduz uma taxonomia do conhecimento, que consiste em uma visão alterativa em relação as taxonomias até então existentes. Como implicação prática, estes quatro tipos identificados de conhecimento apontam para a necessidade de desenvolvimento de práticas específicas de gestão do conhecimento para cada tipo de conhecimento.

Palavras-chave: ground theory. taxonomia do conhecimento. gestão do conhecimento. classificação do conhecimento. rotinas organizacionais.

1. Introduction

Knowledge is one of the most important organizational assets (CHRISTIANO *et al.* 2016; HENRIQUES, 2013), as it is a direct and essential pre-requisite for executing organizational routines (DENACOLAI, ZUCHELLA; STRANG, 2014; CARLUCCI; SCHIUMA, 2007; TEECE, PISANO; SHUEN, 1997). Accordingly, managerial scholars have paid increasing attention to knowledge issues to understand better its use in productive activities, and to prescribe better knowledge management methods (HEISING, 2009; MAKAMBE, 2015; TRINDADE *et al.* 2011).

Given the cognitive nature of knowledge, psychology scholars have so long studied it (SIMON, 1957; TVERSKY; KAHNEMAN, 1974) and philosophy (FERRAZ et al. 2018; HUSSERL, 1973). However, given the objectives of management research, that is, to study how organizations are structured and operate internally, knowledge concept approach should be used to understand the effects of knowledge on the performance of organizational activities, as well as the structuration and institutionalization of organizational routines. In other words, in the managerial field, the approach to knowledge should be more focused on its “aesthetics” or instrumental aspects, than on its fundamental nature.

As a result, the managerial literature has been devoted to studying ways of managing knowledge, and guided by some basic knowledge classification taxonomies (e.g., AKGUN *et al.* 2008; PEPULIM; FIALHO, 2017; NONAKA; TAKEUCHI, 1995; NONAKA; TOYAMA, 2007; STARY, 2014; VINES *et al.* 2015). A widely-known taxonomy is proposed by Nonaka and Takeuchi (1995), which classifies knowledge in tacit, which is the knowledge embedded in the person which is used to execute a task, and the explicit knowledge, which is the translation of a part of tacit knowledge in language codes. Another approach from an entrepreneurial perspective is presented by Akgun *et al.* (2008), which classifies knowledge as procedural, or knowledge related to the principles of consumer needs, and declarative, which refers to principles of methods required to develop a product. In an organizational perspective Trindade *et al.* (2011) terms the organizational the individual knowledge which is the knowledge which belongs to only an individual in an organizational context, and the organizational knowledge which is knowledge incorporated to all or part of an organization.

Overall, most knowledge taxonomies used in the management field are dialectic; that is, they use a simple classification that considers only two opposite types of knowledge from a given theoretical lens perspective. However, the existence of barely developed taxonomies hinders more effective development of theories and approaches to the development of more precise knowledge management approaches, which can support the improvement of the use of knowledge within organizations.

Additionally, most of knowledge management literature is devoted to research this topic in the context of firms whereas are still scarce studies which approach this theme in the context of public and educational organizations (e.g., CANCHUMANI *et al.* 2017; CHRISTIANO *et al.* 2016; VINES et al. 2015).

In the context of organizations is the execution of organizational routines that manifests knowledge (RIBEIRO; RODRIGUES, 2016). A routine refers to established rules or norms for executing activities within organizations to obtain a given result (CHEN *et al.* 2013; CHAN *et al.* 2007; ASHOK, 2007). As such, this construct may be a useful parameter to identify and classify the forms of knowledge in the context of organizations. The structuration and execution of numerous routines inside an organization require mastery of different types of knowledge (BLOODGOOD, 2012). Owing to the lack of a more detailed approach which considers the types of knowledge in the organizational context, we present the following research question: what are the types of knowledge manifested in the structuration and execution of organizational routines?

Building upon the current knowledge taxonomies and the organizational routines field, this article introduces a taxonomy of types of knowledge manifested in the execution of the routines. This research applies grounded theory in an empirical fieldwork setting of an administrative department of a public university. A new knowledge taxonomy is proposed based on four basic types of manifested knowledge during routine execution, namely: *stable-reproducible*, *problem-solving*, *incrementalshift*, and *paradigmatic-shift*. The basic approaches used to obtain data: open-ended interviews, observation, documental analysis.

As a practical implication, the presentation of different forms of knowledge manifestation poses a way for the development of methods to manage different types of knowledge, which this study also address.

2 Literature Review

2.1 Knowledge taxonomies and their theoretical lenses

As explained in the introductory section, knowledge has been a longstanding issue of interest in philosophy and psychology. In managerial science, it gains an instrumental interest; that is, the concern is more about its effects on organizations than its nature (e.g., CHRISTIANO *et al.* 2016; HEISING, 2009). In other words, the focus in the management field is more on understanding the effects of knowledge as a productive asset (DENICOLAI *et al.* 2014; CARLUCCI; SCHIUMA, 2007; TEECE; PISANO, 1997) than in understanding its substance. As such, albeit there is a vast

literature on knowledge management, literature on how knowledge is manifested in organizational practice is still scarce. In this sense, still, there are few knowledge taxonomies, which mainly have arisen as subadjacent elements in studies, where other knowledge issues were approached.

An example is the taxonomy of knowledge management barriers introduced by Pepulim and Fialho (2017) which assume four kinds of barriers, namely, individual, organizational, cultural and environmental. In the sense of classification of the types of knowledge, probably the most known taxonomy used in the managerial field is that proposed by Nonaka and Takeuchi (1995) which introduces the tacit and explicit knowledge. This taxonomy is widely recognized by other authors (e.g., CHRISTIANO *et al.* 2016; VINES *et al.* 2015; KIMBLE *et al.* 2016; MASSA *et al.* 2018; TRINDADE *et al.* 2011). Under the duality of subjectivity and objectivity and the possibility of expressing something with or without the use of language, tacit knowledge is embedded in the subjectivity, and it is not expressed using language. On the other hand, explicit knowledge can be objectified through the use of language. According to Nonaka and Takeuchi, (2008) the tacit and explicit knowledge are intertwined in a continuous reinforcing cycle, whereas the first is generated and converted in the latter, which in turn contributes for the refinement of the first, in a continuous evolving cycle.

From an entrepreneurial perspective, Akgun *et al.* (2008) elicit procedural knowledge, consisting of knowledge about customer needs, and declarative knowledge, referring to knowledge about activities needed to develop a product. In the organizational rationale, knowledge can be classified as technical, which refers to a specific domain required to perform a specific activity, or organizational, which refers to the functioning of organizational routines (KIMBLE *et al.* 2016). According to Trindade *et al.* (2011) in the context of organization exist the individual knowledge, which is knowledge embedded in the individual, and the organizational knowledge the is knowledge appropriated by the organization and is objectified in its formal documents. This article approaches the organizational knowledge, that is, the knowledge necessary to the structuration and reproduction of organizational routines.

Based on the ancient Greek philosophical principles, knowledge also can be classified as phronesis, techne, and episteme (EISNER, 2002; NONAKA; TOYAMA, 2007; STARY, 2014). Phronesis consists of wisdom generated during practical interaction with reality; techne refers to the ability to create new things in the interaction with reality, and episteme refers to knowledge, which is not dependent on a given

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reality. This type of knowledge transcends particular objects, revealing the “truth,” that is, the mode of functioning of a group of objects in the same class of reality (NONAKA; TOYAMA, 2007). Instances of this last type of knowledge can be found in medical knowledge about the functioning of the heart, in economics in the principles of behavior of economic agents, and so forth. These three types of knowledge are based only on the subjective perspective, and the parameter of classification is the self’s relationship with objective reality.

Nevertheless, from the perspective of subjectivity, it is important to consider how individuals generate knowledge and transfer it to each other (HENRIQUES, 2013). In this sense, Calabretta *et al.* (2017) present two types of generation processes, namely, rational, which is based on the logic chaining of cause and effect rationale, rooted in the Cartesian method of knowledge generation, and intuitive, which is based on a holistic perspective relying on feelings, artistry, and spontaneous creativity. In this respect, Ferraz *et al.* (2018) present a rigorous view of knowledge based on two elements, the epistemological based on a form which the subject generates knowledge, and the ontological process, which refers to the essence of the object which the knowledge is generated.

2.2. Manifested knowledge in organizational routines

Knowledge has a deep relationship with organizational practice, as in several activities it is the basic requirement to execute a routine. A routine refers to the use of standardized rules and methods to attain a given objective in the organizational realm (DENICOLAI *et al.* 2014; OLIVEIRA; QUINN, 2015; CARLUCCI; SCHIUMA, 2007; SANGYOON *et al.* 2016). These rules and methods are replicated indefinitely in multiple instances of the same routine. For example, the steps required to verify the *status* of a piece of equipment in a factory should be almost the same in each instance (equipment 1, equipment 2, ..., equipment n). Accordingly, the execution of each instance of a routine has a certain level of stability and similarity with the previous execution of the same routine; on the other hand, each instance of a routine is unique, bearing a certain level of idiosyncrasy (SANGYOON *et al.* 2016).

As a consequence of the previous reasoning, a routine can be subsumed in two ontological elements (ARNOLD; RAHM, 2014; LEE, YOON *et al.* 2011). On the one

hand, it comprehends a set of rules or norms, which should be followed when the routine is triggered (CONLEY; ENOMOTO, 2005; BINGHAM; EISENHARDT, 2011). Accordingly, the rules and norms transcend specific instances, referred to here as formal elements and the “soul” of the routine in a metaphorical way (GAVRILOVA *et al.* 2015). The other side is the “materialization” of the routine each time it is triggered; that is, the instance of the routine that has an own identity or individuality in the group of instances executed, referred to as the “body” of the routine (CONLYE; ENOMOTO, 2005; HABIB; KROHMER, 2016; SANGYOON *et al.* 2016).

It is subjacent that the execution of a routine will require the mastery of knowledge. Referring to the paradox above presented of regularity (“soul”) and singularity (“body”) of a routine instance, it is possible to deduce two basic types of knowledge. That based on the mastery of the rules necessary to the correct execution of the routine, and that related to the unpredictable events related to every single instance of a routine. As a result, this paper drawing upon the forms of routine execution presents a taxonomy of organizational knowledge and analyses its implication to knowledge management.

3 Method

This research is qualitative and inspired by the grounded theory method. Glaser and Strauss (1967) developed the grounded theory in social science research, advocating the inductive discovery of theories from systematically analyzed data. It is a style of qualitative research that seeks to generate new theories through some basic elements: concepts, categories, and properties and the contact of the researcher with a determined empirical setting. The emphasis of grounded theory is learning from the data rather than from an existing theoretical view.

The first phase of the research was to describe and understand the existing knowledge in the organization. In the second phase, using the similarities and convergence of the mapped knowledge, we sought to propose a typology capable of representing the different types of identified knowledge manifested in organizational routines.

The model outlined was generated through contact of researchers with an academic department (AD) of a Brazilian public university, in the period ranging from

2014 to 2017. Data collection was carried out using several different sources, namely: direct observation of the department's routines; interviews with different actors in the department, including four process managers; access to the department's norms, which define how its routines are executed; and participation in research, involving direct contact with execution of some of the departmental routines. Table 1 summarizes the experimental protocol of the research, highlighting the objective, the people involved, the units of analysis, and the methodology used in the research.

Table 1 – Summary of the data collection procedure

	Objective	People Involved	Units of Analysis	Methodology
First phase	Map existing knowledge in the department studied in the	Managers of the four processes in the department	The administrative processes	four Interviews and analysis of department's documents
Second phase	Identify the Actions of researchers for convergence method. From the cognitive the particularities of processes of knowledge. realize	Actions of the Similarities and Deductive similarities among	Similarities and Deductive similarities among	Deductive similarities among
moment	acquisition and Analysis of the generalizations to then propose a reports generated structure the taxonomy of in the first phase proposed classification of the and study of the taxonomy.	Acquisition and Analysis of the generalizations to then propose a reports generated structure the taxonomy of in the first phase proposed classification of the and study of the taxonomy.	Acquisition and Analysis of the generalizations to then propose a reports generated structure the taxonomy of in the first phase proposed classification of the and study of the taxonomy.	Acquisition and Analysis of the generalizations to then propose a reports generated structure the taxonomy of in the first phase proposed classification of the and study of the taxonomy.
	knowledge	knowledge management	literature	on
	Source: The authors			

The several forms of data were ordered, coded, and compiled in a way that permitted further discussion with the research group in different sessions ranging from 2014 to 2017, approaching the stability and forms of changing routines across time, and how knowledge is manifested in these processes. Through these discussion sessions, the authors developed the model proposed here. As such, corroborating the main assumptions of the grounded theory, the proposed taxonomy arose from the

continuous contact of the research with reality through a systematic procedure of data collection and analysis of multiple data sources.

3.1. The Research Object

The object of study for the present research is an academic department (AD) of a Brazilian public university, whose purpose is to manage research and post-graduate studies in the university. As such, this department develops, implements, and controls policies for supporting research, innovation, and post-graduation. The main services offered by this department are related to i) research - administration of scientific initiation programs, internal and external research funding, teacher release for professional qualification; ii) post-graduation - coordination, supervision, and assistance in the creation of courses and postgraduate programs; iii) innovation - coordination of the university infrastructure to foster and encourage innovation as an incubator, and technological innovation and entrepreneurship. We mapped four routines executed within this department: 1) administration of scientific initiation programs; 2) release from lectures for qualification and participation in events; 3) issuance of diplomas for graduates of postgraduate courses; and, 4) support for the creation of new courses or post-graduate research lines.

4 Results

This section presents four types of knowledge manifested in the organizational routines, based on the direct study of the AD's routines. Firstly, in Section 4.1 outlines a general view of the four types of knowledge identified. In the remaining four sections it is presented a detailed view of each type of knowledge and its examples in the AD.

4.1 Proposition of the knowledge taxonomy

Assuming the uniqueness of each instance of a routine execution, the variability between instances can be understood through a gradual process. Firstly, assuming a

stable execution of a routine, the first source of variability concerns the identity of the element processed in a routine and the output of the routine (CONLYE; ENOMOTO, 2005; HABIB; KROHMER, 2016; SANGYOON *et al.* 2016). For example, even though an automaker uses the same basic routine to manufacture a given car model, each car can be identified individually within its category. As such, in this stage of simple execution of a routine, the knowledge is named as *stable-reproducible knowledge*.

The next stages of a shift in the organizational routine have the underlying assumption that the organization is a system which naturally requires change due to the unpredictability of events, as well as to the opportunity for change posed by new technologies and new forms of rationing (BARRALES-MOLINA *et al.* 2015). In the next level of variability, the execution of a routine can introduce new facts, which will require creativity of the persons responsible for its execution. As such, in these situations take place a new type of knowledge that can be referred as *problem-solving knowledge* (CONLEY; ENOMOTO, 2005; GIAMPAOLI *et al.* 2017; MANIMAY; SOBEK, 2015; REBECCA; SOUDER, 2015), where there is more significant variability than in the previous situation presented, but that in essence is circumstantial.

As time passes, it is common the improvement of the routines in the organizational context (CONLEY; ENOMOTO, 2005; STARY, 2014; HABIB; KROHMER, 2016; FIOL; O'CONNOR, 2017). This process arises from the perception of its executors of possible insertion of improvements in the sense of increasing the performance of the routine. As such, in the third level of knowledge related to the routines, there is the *incremental-shift knowledge*, whereas some rules and/or constituents' elements in the execution of the routine are changed. However, changing in some aspects, it is preserved the same conceptual basis in the routine constitution. Finally, at the fourth level, the inner structure of a routine is changed, undergoing a substantial shift to achieve a significant improvement. In this situation, one can maintain that knowledge manifests as a *paradigmatic-shift knowledge* (SHEPHERD; SUDDABY, 2016; MORGAN, 1980). Based on this discussion, Table 2 outlines a gradual model of knowledge manifestation in the execution of routines.

Table 2 – Stages of knowledge manifestation on formal elements of organizational routines

Stage	Stage 1	Stage 2	Stage 3	Stage 4
Name	Stability-reproducibility	Problem –solving	Incremental-shift	Paradigmatic-shift

Character	Constant	Occasional	Structural	Substantial
	reproduction of routine	improvement of routine structure to the routine based on current technologies and inertia in the routine structure	improvement of the routine based rules in each instance; improve performance assumptions about its independent constitution	the routine tune the routine assumptions independent forms of thinking
Stimulus	Performance external events	Serendipity stability	of Envisioning possible improvements based on current experience	External technologies, radical thinking based on current experience

Source: The authors

4.2 Stable-Reproducible knowledge

This kind of knowledge is one of the most common forms of knowledge since it is present in the execution of repetitive tasks. Two examples of this type of knowledge present in the AD are the knowledge required for the issuance of diplomas for graduates of postgraduate courses and the release of docents for qualification and participation in external events. Each of these routines requires the same steps in each instance. As a result, there is little variability in these two routines, whereas the unique sources of variability are the specific data and documents of the applicants.

Numerous repetitive activities were found in AD. Since this department is in a public university, there are published norms or resolutions for several routines that present general guidelines for their execution. This is the case for the general rule of lecturer release, which is stated in a university norm. However, the execution of a routine is not always explicitly stated in a document in the department. Indeed, when a new employee is asked to perform a task that he or she has not yet attempted, basic information is transferred verbally. Improving this type of knowledge would require the establishment and development of employee training programs and documentation of the rule of the routine indicating each activity to be performed in its execution.

4.3 PROBLEM-SOLVING KNOWLEDGE

Problem-solving knowledge does not require significant changes in mental processes to deal with a given routine; it requires that the process executor adapt his or her repertoire of knowledge to a specific circumstance, thus appropriating the skills and knowledge accumulated through past experiences. An example of the occurrence of problem-solving in the AD is the support for approval of the creation of postgraduate projects. Even though the basic routine for the creation of a postgraduate course can be the same for all kinds of course. The specificity of projects for courses in different knowledge areas (e.g., social sciences, physical sciences, management sciences, and so forth.) will pose particular challenges due to the specificities of each of these areas. Some examples are specific infrastructures and norms of governmental agencies and committees that govern the creation of new courses in each respective area. As such, when executing each routine of course creation, the manager of the course faces typically specific situations that will require problem-solving ability.

4.4 Incremental-Shift knowledge

This type of knowledge refers to the improvement of the execution of a routine, in which the rules of its execution are shifted in the face of an opportunity for improvement or event by the learning process through the experience in execution of a given routine. As such, this situation permeates several routines in the AD, as well as the editing the resolutions that govern the execution of routines to incorporate improvements. This is the case for the scientific initiation routine, which was edited concerning the criteria and scores for granting fees for project execution throughout the years. In this university, there are four committees which the role is to judge and select projects proposed by lecturers. Each committee has the autonomy to set its criteria and scores for evaluating the projects, and these parameters have changed across time to improve the selection process.

However, specific incremental improvements were observed in AD's routines; this process has occurred as a contingency for external events that pose challenges to the efficiency of the routine's execution. As such, a culture of improvement of routines

based on participation of the AD's workers was not observed. This would be a useful measure to improve the performance of this department in this respect.

4.5 Paradigmatic-Shift knowledge

Paradigmatic-shift knowledge manifests itself in situations in which the individual, using his or her previous set of knowledge and abilities, can generate something radically new. This kind of knowledge is the result of the values of the individuals who generate it, their cognitive ability, and their prior knowledge, which generate new mental structures for problem-solving. In its noblest nuance, this knowledge manifests itself in the construction of new paradigms for a given action area or field.

In the AD context, this type of situation occurred in the restructuration in the selection of projects of scientific initiation. In its older form, this process was based on the flow of paper and physical documents of the projects submitted to the AD. This routine was reformulated through the exclusive use of a digital platform to support all activities of assessment of projects, eliminating physical assessments and reports. As such, the development of a new paradigm of execution of this process culminated in the entirely new form of its execution.

Figure 1 summarizes these four types of knowledge and presents examples extracted from AD. One can observe that in the context of the routine execution the necessary knowledge are *stable-reproductive* or *problem-solving*. In another hand, there are two possible types of improvement of the essence of a routine, through the *incremental-shift* and *paradigmatic-shift*.

Instances	Routine constitution
<p>Stable-reproducible Regular repetition of the routine e.g., Flow of diploma issuance</p>	<p>Incremental-shift Improvement in the routine, maintaining its conceptual/technological basis e.g., Improvement of the rule about the scores of selection of scientific initiation projects</p>

<p>Problem-solving Execution of the routine through the creation of a solution to arisen idiosyncrasies in a particular routine instance. e.g., Problem-solving in a particular post-graduating course creation</p>	<p>Paradigmatic-shift Restructuration of a routine through a change in its conceptual/technological basis. e.g., shifting the process of scientific initiation assessment process from physic to a virtual platform</p>
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Figure 1 – Classification matrix of knowledge typologies Source: the authors

5. Analysis

This section is divided into two subsections, whereas in the first it is presented an analysis of the proposed taxonomy, taking into account the literature. The second is devoted to a comparative analysis of the proposed taxonomy with other existing taxonomies in the realm of knowledge management.

5.1. Analysis of the taxonomy under the lights of literature

The above proposed taxonomy introduces conceptual parameters that can be useful to the understanding of the knowledge embedded in the execution and shifting of organizational routines and strives to a more practical view of knowledge in the organizational context, based in more contemporary views, which seeks the knowledge effectiveness (e.g. MASSA *et al.* 2018; STARY, 2014). Firstly, the *stablereproducible* knowledge is day-to-day applied in the execution of the most instances of a routine in a regular manner (HAN *et al.* 2007; CONLEY; ENOMOTO, 2005; SANGYOON *et al.* 2016), which is the case found in the AD. As such, the management of this type of knowledge should be made through two primary forms, through the documentation of the main tasks and rules about its execution, into formal documents, and through the training of the personal through the repetition of the execution of a routine, in the sense to reach the mastery in its execution.

In this same vein, the use of *problem-solving* knowledge poses a slight variation about this first type of knowledge. As such, it presents across the execution of a new instance of an established routine some deviations and unpredictable events that

require from the executor, the development of new solutions, to conclude de execution of the routine (GIAMPAOLI et al. 2017; MANIMAY, SOBEK. 2015; MORGAN, 1980). As well as in the previous case, the management of this type of knowledge should be based on continuous training process, which should insert particular elements in the routine execution that require circumstantial solutions from the executor. In sum, from a metaphorical point of view, these two types of knowledge only interfere in the instances of routines, that is, in its “body.”

In the other hand, *incremental-shift* knowledge and *paradigmatic-shift* knowledge, interfere in the ontological characteristic of the routine (ARNOLD; RAHM, 2014; GAVRILOVA et al. 2015; KIMBLE et al. 2016; LEE et al. 2011), that is, these type of knowledge provokes changes in the “soul” of routine, shifting its internal rules and modes of execution (OLIVEIRA; QUINN, 2015).

However, the *incremental-shift* is usually resulted from the perception of opportunities to improve a given routine and through the experience accumulated in its repetitive execution (BINGHAM; EISENHARDT, 2011; CHEN et al. 2013; GAVRILOVA et al. 2015). Contrarily, the *paradigmatic-shift* usually results from the combination of constructs outside the current mental model used to execute a routine (BARRALESMOLINA et al. 2015; FIOL; O’CONNOR, 2017; MORGAN, 1980). As a result, the management of this type of knowledge should be oriented by a cultural view based on the principles of continuous improvement of routines, that in the case of *incrementalshift* should be guided to the continuous critical assessment of the routine framework in the sense of seeking for improvements (CHEN *et al.* 2013; HABIB; KROHMER, 2016; MANIMAY; SOBEK, 2015). By contrast, the management of *paradigmatic-shift* should rely on more radical actions such as brainstorming sessions, research of new technologies outside the organization, and so forth.

Additionally, it can be used the historical dialectical perspective based on past and immediate post-execution of an organizational routine to analysis the proposed taxonomy. In this sense, the *stable-reproducible* knowledge does not generate new knowledge, remaining the same after the routine execution. However, even the *problem-solving* knowledge generates new knowledge after a given routine execution, this knowledge is circumstantial (BINGHAM; EISENHARDT, 2011), and idiosyncratic to a given instance executed by the routine application (SANGYOON *et al.* 2016). As

such, this new knowledge is not sufficient to be embodied in the current rules, which govern the routine execution.

From the dialectical point of view, *incremental-shift*, as well as *paradigmaticshift* knowledge will produce a new type of knowledge in the historical evolution of the organization, which should be registered in the form of a new set of rules, which will govern the routine execution (OLIVEIRA; QUINN, 2015). However, while the *incremental-shift* knowledge relies upon the current set of knowledge existing in the routine, the paradigmatic brings radically new constructs about it.

5.2. A comparative view of other taxonomies

The proposition of any taxonomy has with a subjacent element the use of conceptual lenses or parameters. In other words, it is necessary to assume one or some parameters to classify some category of the phenomenon under the view of a taxonomy. As such, through the analysis of the taxonomies presented in the literature review, we deduce the conceptual lenses used in each one and render a comparative analysis of these with the proposed taxonomy in this article.

Starting from the Pepulim and Fialho (2017) taxonomy of barriers to the implementation of knowledge management in public services, these authors use two parameters, namely, the individual, which can act solely or in an organized manner, this parameter allows to the presentation of the individual, organizational and cultural barriers concepts. The second parameter is the organizational boundary, which allows these authors to state organizational and environmental barriers. In another hand, Akgun *et al.* (2008) present as conceptual parameter the organizational boundaries, which the procedural knowledge, that is, the knowledge about customer needs is external to the organization, and the declarative is the knowledge about the internal boundaries. In turn, the taxonomy proposed in this article is based only on the organizational routines.

The tacit and explicit approach introduced by Nonaka and Takeushi (1995) has the subjectivity/objectivity as a subjacent parameter of classification. Whereas the explicit knowledge is the objectified knowledge, the tacit is only embedded in the self, that is, it is not codified yet. In this vein, Trindade *et al.* (2001) call the knowledge embedded in the person as individual knowledge, where the knowledge which

becomes inter-subjective in a given group as organizational knowledge. Here, the proposed taxonomy uses only the objective reality, once it assumes the “materialization” of knowledge in the routines. However, it is possible to assume the use of the tacit or individual knowledge in the *problem-solving*, *incremental-shift* and *paradigmatic-shift* knowledge.

The parameter used by Kimble *et al.* (2016) is the ontological content of knowledge, which is classified in technical or organizational. In this paper, it was approached the AD which is an administrative department as a research object. As such, *a priori* this taxonomy is adequate to the organizational contexts. Although, this approach can be directly used to map and understand the variations of knowledge in technical fields of the organization.

The taxonomy based on the concepts of phronesis, techne, and episteme (EISNER, 2002; NONAKA; TOYAMA, 2007; STARY, 2014) uses as parameter the duality between the real and the abstract, whereas the two first is based on the reality, and the later is based on the abstract. In parallel, the two first types of knowledge of the taxonomy proposed here (*stable-reproducible* and *problem-solving*) are related to the execution of routines in the objective reality, whereas the two last (*incrementalshift* and *paradigmatic-shift*) are related to the abstract realm.

Ultimately, to distinguish the proposed taxonomy of the others presented above, it presents an integrative view, which links the knowledge concept with the organizational concept in a pragmatic way. As a result, the idea of “materialize” the knowledge, seeks to present a set of four constructs, the four types of knowledge, which permit to understand the regularity and variability (CONLEY; ENOMOTO, 2005; HABIB; KROHMER, 2016; SANGYOON *et al.* 2016) in the context of organizational operations.

6 Conclusion

This article argues that it is necessary the development of a more in-depth understanding of the knowledge for the development of more efficient knowledge management practices in the context of organizational routines, in line with a pragmatic and effectiveness view of knowledge (MASSA *et al.* 2018; STARY, 2014). As a result, it is introduced four types of knowledge based on the historical execution of

organizational routines, namely, *stable-reproducible*, *problem-solving*, *incrementalshift*, and *paradigmatic-shift*. Although, this approach assumes four existing forms of knowledge manifestation, or in other words, “materialization” in the execution (expressed by *stable-reproducible* and *problem-solving* knowledge) and structuration of organizational routines (expressed by *incremental-shift* and *paradigmatic shift knowledge*).

This paper contributes to both theoretical and practical realms. From the theoretical point of view, this paper proposes a new alternative view to the current knowledge taxonomies (e.g., AKGUN *et al.* 2008; TAKEUCHI, 1995; NONAKA; TOYAMA, 2007; STARY, 2014; VINES *et al.* 2015), complementing these existing views. Additionally, it is presented a new taxonomy which can be used with other taxonomies (e.g., PEPULIM; FIALHO, 2017) in the knowledge management literature for a more comprehensive understanding of the knowledge concept and its practical implications to the organization's routines. Another contribution of this taxonomy is that it can be used to understand the level of stability and innovation of organizations, through the investigation of the stability and change in the execution and configuration of its routines across the time. This approach seeks to direct objectification of the knowledge across the routines, through two basic forms, embedded in their execution and structuration.

From its implication to the practice, the existence of different types of knowledge implies that each type demands a specific form of management and personal training as proposed in Section 5.

Finally, this paper presents new research opportunities in the sense of the development of specific knowledge management techniques for each type of knowledge. Additionally, some possibilities of research departing from this taxonomy are: to study the relations between these four types of knowledge through a longitudinal perspective in an organization; study the level of inertia/dynamism of an organization through the level of shift of its routines.

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