A KNOWLEDGE TAXONOMY IN THE CONTEXT OF ORGANIZATIONAL ROUTINES: an study in a public university

UMA TAXONOMIA DO CONHECIMENTO NO CONTEXTO DAS ROTINAS ORGANIZACIONAIS: um estudo em uma universidade pública

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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. As such, the concept of knowledge is overlooked in the literature. Hence, this situation poses a dilemma: how could a thing that is not well understood be adequately managed? Drawing on current knowledge taxonomies and the organizational routines concept, we address this gap by outlining a taxonomy of how knowledge is manifested 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, it was identified four basic types of knowledge: *stable-reproducible*, *problem-solving*, *incremental-shift*, and *paradigmatic-shift*. As main theoretical contribution, this paper introduces a knowledge taxonomy, which is an alternative view in relation to the current taxonomies. As a practical implication, these four types of knowledge presented point out to the necessity of the development of specific knowledge management practices for each type of knowledge.
Keywords: Znowledge taxonomy. Knowledge management techniques. Grounded theory.

RESUMO
O conhecimento é um dos ativos mais importantes nas organizações. Embora existam vários estudos sobre gestão do conhecimento, há poucos textos dedicados a classificar os tipos de conhecimento existentes. Como tal, o conceito de conhecimento é negligenciado na literatura. Assim, esta situação coloca um dilema: como poderia uma coisa que não é bem compreendida ser adequadamente gerenciada? Com base nas taxonomias do conhecimento atual e no conceito de rotinas organizacionais, abordamos essa lacuna delineando uma taxonomia de como o conhecimento se manifesta na execução e estruturação de rotinas organizacionais. Essa taxonomia é gerada através do processo de fundamentação do exame das rotinas organizacionais de um departamento acadêmico em uma universidade pública. Como principal resultado, foram identificados quatro tipos básicos de conhecimento: reprodutível-estável, resolução de problemas, deslocamento incremental e mudança paradigmática. Como principal contribuição teórica, este artigo introduz uma taxonomia do conhecimento, que é uma visão alternativa em relação às taxonomias atuais. Como implicação prática, esses quatro tipos de conhecimento apresentados apontam para a necessidade do desenvolvimento de práticas específicas de gestão do conhecimento para cada tipo de conhecimento.

Palavras-chave: Taxonomia de conhecimento. Técnicas de gerenciamento de conhecimento. Teoria fundamentada.

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1 INTRODUCTION

Knowledge is one of the most important organizational assets (CHRISTIANO *et al*. 2016), as it is a direct and essential pre-requisite for executing organizational routines (DENACOLAI, ZUCCHELLA; 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).

Given the cognitive nature of knowledge, it has long been studied in psychology (SIMON, 1957; TVERSKY; KAHNEMAN, 1974) and philosophy (HUSSERL, 1973). However, given the objectives of management research, that is, to study how organizations are structured and operate internally, the 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, managerial literature has been devoted to study ways of managing knowledge, and has been 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 a person's embodied knowledge used to execute a task, and explicit, 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. 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, improving the use of knowledge within organizations.

Additionally, most of the 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 (CANCHUMANI *et al*. 2017; CHRISTIANO *et al*. 2016; VINES et al. 2015).

In the context of organizations, knowledge is manifested in the execution of organizational routines. 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 in which knowledge is manifested in the organization. The structuration and execution of numerous routines inside an organization require mastery of different types of knowledge (BLOODGOOD, 2012). Owing to the lack of approaches which consider 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 routines execution. This research applies grounded theory in an empirical fieldwork setting of an administrative department of a public university. Relying on open-ended interviews, observation, document analysis, and using organizational routines as a classification parameter, a new knowledge taxonomy is proposed based on four basic types of manifested knowledge during routine execution, namely: *stable-reproducible*, *problem-solving*, *incremental-shift*, and *paradigmatic-shift*.

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 is also addressed in this study.

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 (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 subjacent 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 based on the two types of knowledge, the tacit and explicit knowledge, which was introduced by Nonaka and Takeushi (1995) and widely referred by other authors (CHRISTIANO *et al*. 2016; VINES *et al*. 2015; KIMBLE *et al*. 2016; MASSA *et al*. 2018). Under the duality of subjectivity and objectivity and the possibility of expressing something with or without the use of language, tacit knowledge is embodied 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 Takeush, 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). 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 the knowledge, which is not dependent on a given 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. 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.

2.2. Manifested knoweldge in organizational routines

Knowledge has a deep relationship with organizational practice, as in several activities it is the basic element required 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 is composed of 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 the one 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 the 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 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**	**Analysis Units**	**Methodology**
First phase	Map existing knowledge in the department	Managers of the four processes studied in the department	The four administrative processes	Interviews and analysis of department´s documents
Second phase moment	Identify the similarities among cognitive processes of knowledge acquisition and then propose a taxonomy of classification of the knowledge	Actions of the researchers for the interpretation of reality	Similarities and convergence among the mapped knowledge. Analysis of the reports generated in the first phase and study of the literature on knowledge management	Deductive method. From the particularities of the AD, we tried to realize generalizations to structure the proposed taxonomy.

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 the way in which knowledge is manifested in these processes. Through these discussion sessions, the authors developed the model proposed here. As such, corroborating the main assumptions of grounded theory, the proposed taxonomy arose from

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

3.1 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 DATA 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. it is presented 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's execution, the variability can be understood through a gradual process. First, assuming a routine's stable execution, 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*.

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* (CONLEY; ENOMOTO, 2005; GIAMPAOLI *et al*. 2017; MANIMAY; SOBEK, 2015; REBECCA; SOUDER, 2015), where there is more significant variability than in prior situations of the routine, but that in essence is circumstantial.

At the third level, called *incremental-shift* knowledge, the conclusion of a given routine will require more than a circumstantial problem-solving approach, where the formal elements of the routine will be changed to attain improvement. Thus, in this situation, one can argue that new knowledge is manifested as an incremental improvement in the routine (CONLEY; ENOMOTO, 2005; STARY, 2014; HABIB; KROHMER, 2016; FIOL; O'CONNOR, 2017).

Finally, at the fourth level, the inner structure of a routine is changed, undergoing substantial shift to achieve a significant improvement. In this situation, one can maintain that knowledge is manifested as a *paradigmatic-shift* (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 reproduction of the routine rules in each instance; inertia in the routine structure	Occasional intervention in the routine structure to tune the routine to improve performance requirements	Structural improvement of the routine based on current assumptions about its constitution	Substantial improvement of the routine based on new technologies and independent forms of thinking
Stimulus	Performance stability	Serendipity of external events	Envisioning possible improvements based on current experience	External technologies, radical thinking

Source: The authors

4.2 Stable-reproducible knowledge

This kind of knowledge is one of 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 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 the AD. Since this department is included 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 resolution. 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 passed 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 the process executor to 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 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 the specificities of each of these areas, such as 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 is manifested in 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 whose 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 has changed across the 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, 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 the AD´s.

Figure 1 – Classification matrix of knowledge typologies

Stable-reproducible Regular repetition of the routine e.g., Flow of diploma issuance	**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
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	**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

Source: the authors

5 ANALYSIS

This section is divided into two subsections, whereas the in the first it is presented an analysis of the proposed taxonomy, taking in account 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 *stable-reproducible* 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 in relation to 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 requires 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 of the executor. In sum, from a metaphorical point of view, these two types of knowledge only interferes in the instances of routines, that is, in its "body."

In the other hand, *incremental-shift* knowledge and *paradigmatic-shift* knowledge, interfer 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 is result from the combination of constructs outside the current mental model used to execute a routine (BARRALES-MOLINA 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 *incremental-shift* 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 *paradigmatic-shift* 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 the organizational and the 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. 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 embodied 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 a administrative department as 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.

Finally, the taxonomy recognized by Eisner, 2002; Nonaka; Toyama, 2007; Stary, 2014) which presents the phronesis, techne, and episteme uses as parameter the duality between the real and the abstract, whereas the two first are 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 (*incremental-shift* 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*, *incremental-shift*, 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 the theoretical and practical realms. From the theoretical point of view, this paper proposes a new alternative view to the current knowledge taxomies (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 of its routines across the time. From the rest, 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, as proposed in Section 5. As such, this paper presents new research opportunities in the sense of the development of specific knowledge management techniques for each type of knowledge. It is especially relevant to the development of types of knowledge not yet covered adequately in literature, referred to here as *incremental-shift* and *paradigmatic-shift*.

REFERENCES

ARNOLD, P.; RAHM, E. Enriching ontology mappings with semantic relations. **Data & Knowledge Engineering**, v.93, p.1–18, 2014.

AKGUN, A. E.; DAYAN, M.; BENEDETTO, A. New product development team intelligence: antecedents and consequences. **Information and Management***,* v.40, p.221-226, 2008.

ASHOK, J. Moving beyond tacit and explicit distinctions: a realist theory of organizational knowledge. **Journal of Information Science***,* v.33, n.6, p.752–766, 2007.

BARRALES-MOLINA, V.; MONTES, F. J. L.; GUTIERREZ-GUTIERREZ, L. J. Dynamic capabilities, human resources and operating routines: A new product development approach. **Industrial Management & Data Systems***,* v.115, n.8, p.1388–1411, 2015.

BINGHAM, C. B.; EISENHARDT, K. M. Rational heuristics: the 'simple rules' that strategists learn from process experience*.* **Strategic Management Journal***,* v.*32,* 1437–64, 2011*.*

BLOODGOOD, J. M. Organizational routine breach response and knowledge management. **Business Process Management Journal***,* v.18, n.3, p.376–399, 2012.

CALABRETTA, G.; GEMSER, G.; WIJNBERG, N. M. The interplay between intuition and rationality in strategic decision making: A paradox perceptive. **Organization Studies***,* v.*38*, n.3-4, p.365–401, 2017.

CANCHUMANI, R. M. L; LETA, J.; FIGUEIREDO, A. M. Domínio Científico: Mapeamento das Áreas de Conhecimento da Universidade Federal do Rio de Janeiro, **Informação & Sociedade**, v.27, n.2, p.199-218, 2017.

CARLUCCI, D.; SCHIUMA, G. Knowledge assets value creation map: Assessing knowledge assets value drivers using AHP. **Expert Systems With applications***, v.32*, n.3, p.814–821, 2007.

CHAN, P.; PAN, G.; CHEN, A.; HSIEH, M. H. The dynamics of implementing and manage modularity of organizational routines during capability development: Insights from a process model. **IEEE Transactions of Engineering Management,** v.*54*, n.4, p.800–813, 2007.

CHEN, J.; HUA, O. T.; PAN, S. L. The role of feedback in changing organizational routine: A case study of Haier China. **International Journal of Information Management***,* v.*33*, n.6, p.971–974, 2013.

CHRISTIANO, A. C. L. GOHR, C F. GOMES, M. L. B. Conhecimento como recurso estratégico em uma instituição de enino superior: uma análise sob a ótica dos professores. **Informação & Sociedade**, v.26, n.1, p.131-150, 2016.

CONLEY, S.; ENOMOTO, E. K. Routines in school organizations: Creating stability and change. **Journal of Educational Administration***,* v.43, n.1, p.9-21, 2005.

DENICOLAI, S.; ZUCCHELLA, A.; STRANG, R. Knowledge assets and firm international performance. **International Business Review**, v.23, n.1, p.55-62, 2014.

EISNER, E. W. From episterme to phronesis to artistry in the study and improvement of teaching. **Teaching and Education***,* v.18, p.375-385, 2002

FIOL, M.; O´CONNOR, E. Unlearning established organizational routines – Part I. *The Learning* **Organization***,* v.*24*, n.1, p.13-29, 2017.

GIAMPAOLI, D.; CIAMBOTTI, M.; BONTIS, N. Knowledge management, problem solving and performance in top Italian firms. **Journal of Knowledge Management***,* v.21, n.2, p.355–375, 2017.

GLASER, B.E.; STRAUSS, A. **The discovery of grounded theory**. Chicago: Aldine. 1967.

GAVRILOVA, T.; LESHCHEVA, I.; STRAKHOVICH, E. Gestalt principles of creating, learning business ontologies for knowledge codification. **Knowledge Management Research & Practice**, v.13, p.418-428, 2015.

HABIB, J.; KROHMER, C. Balanced routines: The case of two routines dynamics in a French hospital. **Journal of Organizational Change Management***,* v.*29*, n.4, p.508-528, 2016.

HEISING, P. Harmonisation of knowledge management – comparing 160 km frameworks around the globe. **Journal of Knowledge Management**, v.13, n.4, p.4-31, 2009.

HUSSERL, E. **The idea of phenomenology***.* The Hague: Nijhoff., 1973.

KIMBLE, C.; VASCONCELOS, J. B.; ROCHA, A. Competence management in knowledge intensive organizations using concensual knowledge ontologies. **Information Systems Frontiers**, v.18, p.1119-1130, 2016.

LEE, J.; YOON, J.; SEO, W.; KIM, K.; KIM, C. A fact-oriented ontological approach to human process modelling for knowledge-intensive business services. **Expert Systems With Applications**, v.38, p.12281–12292, 2011.

MAKAMBE, U. Perspectives on knowledge management: a literature review. **Information and Knowledge Management**, v.5, n.1, 88-97, 2015.

MANIMAY, G.; SOBEK, II, D. K. A problem-solving routine for improving hospital operations. **Journal of Health Organization and Management**,v.29, n.2, p.252–270, 2015.

MASSA, H. C. O.; DAMIAN, I. P. M.; VALENTIM, M.L. P. Competência em Informação no Apoio a Gestão do Conhecimento. **Informação & Sociedade**, v.28, n.1, p.257-267, 2018.

MORGAN, G. Paradigms, metaphors, and problem solving in organization theory. **Administrative Science Quarterly**, v.*25*, p.605–622, 1980.

NONAKA, I.; TAKEUCHI, H. **The knowledge-creating company**. New York: Oxford University Press, 1995.

NONAKA, I.; TAKEUCHI, H. **Teoria e criação do conhecimento organizational.** In H. Takeuchi & I. Nonaka (Eds.), Gestão do Conhecimento (p.54-90). Porto Alegre: Bookman, 2008.

NONAKA, I.; TOYAMA, R. Strategic management as distributed practical wisdom (phronesis). **Industrial and Corporate Change**, v.*16*, n.3, p.371–394, 2007.

OLIVEIRA, J.; QUINN, M. Interactions of rules and routines: re-thinking rules. **Journal of Accounting & Organizational Change**, v.11, n.4, p.503–526, 2015.

PEPULIM, M. E. H.; FIALHO, F. A. P. Vervákis, G. Barreiras culturais à efetivação da gestão do conhecimento nas organizaões públicas: Relato de Pesquisa. **Informação & Sociedade**, v.27, n.3, 219-240, 2017.

REBECCA, A. R.; SOUDER, D. Facilitating tacit knowledge transfer: Routine compatibility, trustworthiness and integration in M & As. **Journal of Knowledge Management**, v.19, n.2, p.257-276, 2015.

SANGYOON, Y.; KNUDSEN, T.; BECKER, M. C. (2016). Inertia in routines: A hidden source of organization variation. **Organizational Science**, v.27, n.3, p.782-800.

SHEPHERD, D.A.; SUDDABY, R. Theory building: A review and integration. **Journal of Management**, v.43, n.1, p.59–86, 2016.

SIMON, H.A. **Administrative Behavior: A study of decision-making processes in administrative organizations** (2nd ed.). New York: Macmillan, 1957.

STARY, C. Non-disruptive knowledge and business processing in knowledge life cycles – aligning value network analysis to process management. **Journal of Knowledge Management***,* v.18, n.4, p.651–666, 2014.

TEECE, D. J.; PISANO, G.; SHURN, A. Dynamic capabilities and strategic management. **Strategic Management Journal,** v.18, n.7, p.509–533, 1997.

TVERSKY, A.; KAHNEMAN, D. Judgment under uncertainty: Heuristics and biases. **Science**, v.*85, n.*4157, p.1124-1131, 1974.

VINES, R.; JONES, M.; McCARTHY, G. Collaborating across institutional and jurisdictional boundaries: Enabling the emergence of a national innovation system through public knowledge management. **Knowledge Management Research & Practice***,* v.13, p.187–197, 2015.

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