

Ontological Levels in the Knowledge Management Field

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ABSTRACT

The purpose of this study is to examine the relationship between knowledge and reality in the field of management, highlighting the importance of ontological support in the formation of knowledge. The empirical study establishes those ontological levels in large Spanish firms. The article underlines the importance of ontological support and of practice carried out in forming knowledge, and reviews different approaches. The empirical study identifies, via an exploratory factor analysis, the ontological supports of knowledge in large Spanish firms, going on to apply a confirmatory factor analysis that shows the fit of the factors obtained from the sample. The discussion carried out suggests the desirability of widening and deepening the ontological bases of knowledge. The empirical study identifies that, for the sample studied of large Spanish firms, *individual-group ontological support of knowledge* is significant, along with ontological organizational (and institutional) support of knowledge.

The limitations of the article have to do with the difficulties involved in carrying out the fieldwork for the empirical research of all the relevant questions discussed in the theoretical framework. In so far as the process of the formation of knowledge resides in practice, when it has not yet become conceptual knowledge, the statistical empirical research of these questions presents a number of difficulties.

This article broadens the perspective of Tsoukas and Spender, emphasizing the importance of practice and highlighting the fact that its consideration as the basis and source of knowledge requires the ontological bases to be broadened to include the physical and technological context.

Keywords: *knowledge creation; knowledge management; ontological support; constructivist view; cognitive view*

I. INTRODUCTION

The underlying purpose of this study is to examine the relationship between knowledge and reality in the field of management. All forms of our actions upon reality (know-how, technology, organizational routines and differing practices) or of our understanding of the world (systematic organization of ideas and concepts) are *forms of knowledge*; and all the ways in which physical, technical or social reality manifests itself as a consequence of the nature or human action, are the *supports* on which knowledge is founded.

The *epistemological dimension of knowledge is concerned with its different forms or types*. The *ontological dimension* deals with the physical, technical or social supports *on and in interaction with which* knowledge is created. Our purpose is to highlight the importance of ontological support and the practices that go with it. The formation of knowledge, our understanding of the world and our capacity to act on it depend on how physical, technical and social reality are interwoven with human action; a question that requires a good deal of in-depth analysis. In general, the literature on knowledge has laid much more emphasis upon the epistemological dimension than on the ontological one, and in any case, when addressing the importance of context as an ontological support, it is normally done within the limits of a cognitive approach.

Sections two and three of this study go into a certain amount of detail on the question indicated in the preceding two paragraphs. Section four, through an empirical study of large Spanish firms, identifies the ontological supports of knowledge. Finally, section five discusses the results and presents some conclusions with suggestions for a wider research agenda for knowledge management.

II. THEORETICAL FRAMEWORK

The hands and minds of the members of an organization (managers, technical experts and employees), their formal technical and social relationships (management team, committees, work groups), other informal relationships, databases and the series of installations linked to obtaining the products and/or services of the firm make up the physical and social support, the *ontological support*, of knowledge. Based on this support and particularly on some of the components that go to make it up, arises knowledge linked to the different practices and experience accumulated through them.

The *supports for knowledge* and *knowledge itself* should be separated to carry out the analysis and conceptually order its different components and dimensions. The supports *on which* and *in which* knowledge is produced form the basis for the *ontological dimension*, and the identification and analysis of the knowledge produced will pave the way for the *epistemological dimension*. The first of these, in a *cognitive analysis* of knowledge in organizations, refers to individual members of the organization, its groups and the organization as a whole (Nonaka and Takeuchi, 1995: 57; Crossan, Lane and White, 1999: 523).¹ The second refers to different types of knowledge, and in this sense, contributions that refer to the organization and the economy propose a wide range of names and descriptions.

Some of these correspond to *particular circumstances of time and place* (Hayek, 1945), knowledge *linked to information* (Arrow, 1973; Williamson, 1985), *specific knowledge* (Fama and Jensen, 1983a,b), *tacit* and *explicit* knowledge (Polanyi, 1962;

Nonaka, 1991), *analyzable* or *non-analyzable* knowledge (Perrow, 1967, 1970), *human capital* (Becker, 1993), *organizational routines* (Nelson and Winter, 1982), *core competences* (Prahalad and Hamel, 1990), and knowledge *linked to the organizational context and to practice* (Weick and Roberts, 1993; Tsoukas, 1996; Spender, 1996, 2007, 2008).

The complexity of the epistemological dimension, as shown by the previous paragraph, is evident. Some of the questions underlying the different names are, firstly, that *creating knowledge consists of combining* (interacting with the internal and external context, and emphasizing practice); but *knowing consists of breaking down* (distinguishing, ordering and conceptually labeling). Secondly, and in the same sense, the two types of more general knowledge, and which embrace all the other types, correspond to the *knowledge of concrete situations* (ontologically infinite), and to *abstract or conceptual knowledge* of an *intersubjective* nature (which we consider to be *scientific knowledge*). Finally, one stream of thought, the *cognitive view* (Polanyi, 1962; Nonaka, 1991), examines abilities and skills and their relationship with conceptual knowledge (the thinking in the mind); whilst the *constructivist view* (the enactment described by Weick, 1969) examines the way in which the members of an organization relate to the material and social world, obtaining knowledge in order to transform it (the thinking in the mind, but as a result of the environment) (Weick and Robert, 1993; Spender, 2008: 168).

The distinction between knowledge of particular situations (concrete) and abstract or conceptual knowledge, along with the differences between constructivist and cognitive view, can help to come up with a general classification of the different ways in which knowledge is labeled. Table 1 shows this classification but adds the column *other approaches* in order to include the labels for knowledge that exclude the concepts of cognitive view or constructivist view. This table also excludes the concept of intersubjectivity from abstract or conceptual knowledge as, in organizations, explicit knowledge depends upon its particular idiosyncratic environment. Some forms of knowledge have two dimensions and are classified into two different boxes.

Table 1
A classification of different labels and types of knowledge

	Constructivist view	Cognitive view	Other approaches
Knowledge of particular situations	<ul style="list-style-type: none"> • Organizational routines • Core competences • Knowledge linked to concept and practice 	<ul style="list-style-type: none"> • Tacit knowledge • Non-analyzable knowledge 	<ul style="list-style-type: none"> • Knowledge of particular circumstances of time and place • Specific knowledge
Abstract, conceptual knowledge	<ul style="list-style-type: none"> • Organizational routines • Core competences 	<ul style="list-style-type: none"> • Explicit knowledge • Analyzable knowledge 	<ul style="list-style-type: none"> • Knowledge linked to information • Human capital

III. ONTOLOGY AND EPISTEMOLOGY IN KNOWLEDGE AND KNOWLEDGE CREATION

Should ontology and epistemology be joined or separated? We have stated that the *supports of knowledge* and *knowledge in itself* should be separated in order to carry out the analysis and to order their different components; but also that *creating knowledge consists of combining*, of interacting with the internal and external context, and laying greater emphasis on practice. If we want to know what the world is like at a given moment, we need to stop time, separate and analyze. If we want to know how the world is transformed, how learning and experience are accumulated and how knowledge is created, we should make an in-depth examination of how physical, technical and social reality is interwoven with human action. The former is essential and allows us to ascertain the state of the world; the latter is also vital and enables us to understand how it changes and transforms. Physical, technical and social reality is *ontic*; the support and framework for our existence. The forms of human action that correspond to procedures and methods, in particular when they refer to systematic knowledge or the understanding and order of conceptual knowledge, they belong to *epistemology*. Mir and Watson (2000: 941) refer to the constructivist methodology highlighting that the lead role played by human action in the world management (and in scientific construction) leads to an *epistemological relativism*, whilst maintaining an *ontological realism*. However, Spender (2008) underlines the fact that, although our vision is influenced by the nature of things, the decisive factor is that things (ontology) take on the aspect that our vision attributes it with.²

Put differently, out of the infinite aspects that reality contains, the method or procedure that we use for understanding it selects only some of them in such a way that epistemological relativism inevitably turns into ontological support. Everything is relative and depends upon the conventions of the community (of managers or scientists that deal with a system of concepts or a paradigm. However, the nature of things manifests itself in the business world via the different markets and industries that require varying technologies in order to obtain the range of products and services. Such a system equally requires different forms of work, different levels of knowledge possessed by employees and different forms of administration. In studies of a very different nature, this fact is underlined by the contingent approach (Burns and Stalker, 1961; Donaldson, 2001; Yin and Zajac, 2004); even though the way in which reality conditions us can be altered by the way we perceive it (Prahalad and Bettis, 1986) and by our actions, which can modify it (Weick, 1969; Child, 1997; Hambrick, 2007).

Another important question, which derives from the relationship between reality and the way we act upon it, corresponds to *change*. The sequence formed by knowledge creation, new knowledge, innovation, change in the conditions of competition (or the environment), has its origins in the *infinite nature of concrete reality* and in the *way in which we penetrate it through practice*, by means of our a priori and our experience. Ultimately, this is what the *planning for innovation* consists of suggested by Hamel and Prahalad (1994), the *parallel structures* of Nonaka and Takeuchi (1995), or the *entrepreneurship activity* proposed by Zotto and Gustafsson (2008: 97) (an “innovation, venturing and strategic renewal”). It is a matter of establishing the contextual conditions that enable immersion into reality (partially bounded by the aims of the

firm), thereby making its transformation possible. In this way, together with new knowledge, the *ontic* nature of its support will also change.

New knowledge (episteme) cannot exist without it being founded on new aspects or dimensions of a physical, technical or social nature (*ontic* aspects). Going further than a merely cognitive conception, knowledge takes over reality and in so far as new aspects of reality are discovered or transformed (Spender, 2007, 2008); and bearing in mind that reality is ontologically infinite, this is a bottomless source of possible inventions and innovations and represents the ultimate explanation of change through leading innovative firms and their corresponding sectors or industries. It is not change that forces us to modify our behavior; it is our actions that modify the physical, technical and social support which lead to change. The *infinity of concrete things*, of concrete reality, is the endless source of knowledge, innovation and change.³

The forms of knowledge called *knowledge of particular circumstances of time and place, specific, tacit, non-analyzable knowledge, knowledge of a relevant part of organizational routines and core competences, and knowledge linked to the organizational context and to practice* (table 1), are all forms of experience and practical knowledge of concrete reality. They are forms of acting in the world that can only be partially incorporated in the processes of thinking in the mind (explicit or analyzable knowledge). The knowledge embedded in reality cannot only be conceptualized knowledge, it is, at the same time, and necessarily, a knowledge of practice close to reality and which depends, to a large extent, on what that reality is like.

All the discussion contained above is relevant to this study because it examines *ontological levels and knowledge management*, and the ontological supports in which knowledge is produced (Nonaka and Takeuchi, 1995; Crossan, Lane and White, 1999). For Nonaka and Takeuchi (1995: 59), in reference to the ontological dimension, “[i]n a strict sense, knowledge is created only by individuals”, although “[t]he organization supports creative individuals or provides context for them to create knowledge”, and “[o]rganizational knowledge creation (...) should be understood as a process that organizationally amplifies the knowledge created by individuals”. The ways in which the organization lends support to the individual and collective creation of knowledge corresponds, on an ontological level, to individuals, groups, the organization as a whole, and interorganizational processes; and on an epistemological level, knowledge is created via the interaction between tacit and explicit knowledge, in a process of transformation that goes through the stages of socialization, externalization, combination and internalization (SECI model).

The parallels between this model and the later contribution by Crossan, Lane and White (1999) are important. For Crossan *et al.* (pp. 523-525), ontological levels that lend support to learning correspond to the first three suggested by Nonaka and Takeuchi: individual, group and organizational; and on an epistemological level, knowledge is created through the stages of intuiting, interpreting, integrating and institutionalizing, and their interaction. The intuiting stage (individual practice and experience, images and metaphors), similar to the socialization stage described by Nonaka and Takeuchi, but according to the latter authors (1995: 62) “socialization is a process of sharing experiences and thereby creating tacit knowledge such as shared

mental models and technical skills". Consequently, the technical support is different. According to Crossan *et al.* (p. 526) it is individual, whilst it is simultaneously individual and group-oriented in Nonaka and Takeuchi.

In the remaining stages of knowledge creation, the coincidences between the model of Nonaka and Takeuchi and that of Crossan *et al.* are greater. Interpreting, *mutatis mutandis*, can be viewed as the externalization stage of knowledge that occurs between the ontological group and organizational levels; integration is analogous to the combination of knowledge, or the diffusion within the organization of explicit knowledge, proposed by Nonaka and Takeuchi; and institutionalizing implies incorporating new knowledge in to the functioning of the organization as a whole, both in managerial and operational practice, leading to new situations that will start new learning processes (the internalization of knowledge described Nonaka and Takeuchi, 1995: 69-70).

Both models are important contributions to the theory of knowledge, in spite of the fact that their approach is essentially cognitive. Looking further than the richness of the ideas contained therein and the abundance of important details in both approaches, their proposal leads to an excessive separation between *ontological support* and *knowledge creation*, in such a way that, as we have discussed, there is more of an emphasis on the epistemological process in itself (the interaction between different types of knowledge) than the dynamics between ontology and epistemology (the relationships between reality and knowledge through practice).

What this article highlights, as a result of the previous discussion, is the importance of examining two questioned in particular. Firstly, it deals with the *ontological support-knowledge creation* relationship. Secondly, by comparing the work of Crossan *et al.* (1999) and Nonaka and Takeuchi (1995), we can address the following questions. On what ontological supports is knowledge created? On *individuals, groups and the organization*, are they independent or do they have close interaction with one another as entities? Or is the individual level, which is undoubtedly essential, swallowed up by the group, as Nonaka and Takeuchi suggest, leading to *groups and the organization* as the only ontological levels? These last questions have been investigated in the empirical study we will now go on to describe.

Consequently, the hypotheses for contrast are:

H1. The creation of knowledge by individuals (intuiting, tacit knowledge) has, as ontological support, the individual that learns and physical, technical and social objects that are the focus of their activity.

H2. The creation of individual or collective knowledge (intuiting, interpreting, tacit and explicit knowledge,) simultaneously has, as ontological support, the individual and group that learn and physical, technical and social objects that are the focus of their activity.

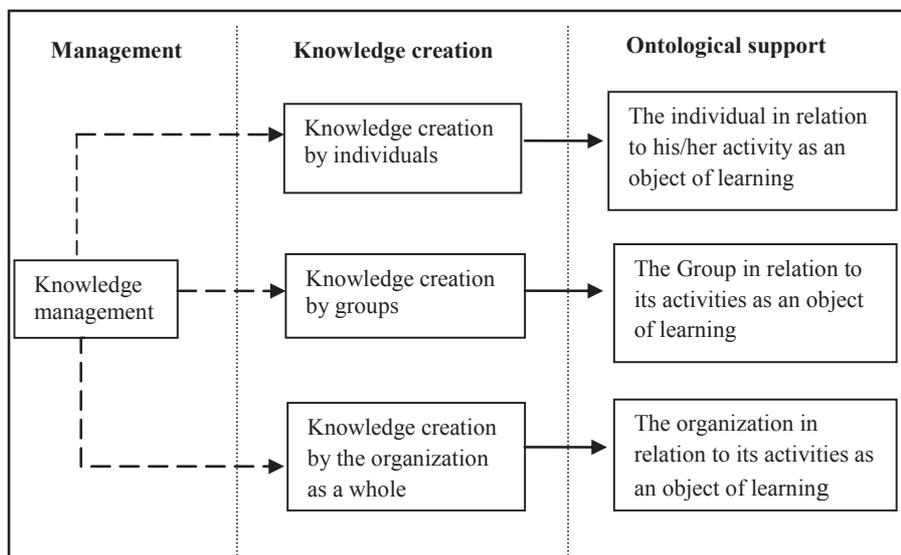
H3. The creation of knowledge in the organization as a whole (integrating and institutionalizing through combination and internalization), has, as ontological support, all the managerial and operational levels of the organization, all its areas and the set of beliefs and know-how that go with them, together with the physical, technical and social objects that are the focus of their activity.

In the three hypotheses formulated, the relationship between knowledge creation and the physical, technical and social objects upon which learning is produced is situated further than the limits of the cognitive approach of Crossan *et al.* (1999). This

can also be said, though to a slightly lesser extent, with regard to Nonaka and Takeuchi (1995). The relationship with physical, technical or social objects highlights the importance of practice in the formation of knowledge (Spender, 2007, 2008) and the fact that its creation requires ontological support which exceeds that of its individual members or collectives within the organization.

Figure 1 shows the theoretical model. The continuous lines indicate what we will go on to assess in the empirical study.

Figure 1
Model for knowledge creation



IV. EMPIRICAL STUDY

A. Approach

The population for this research consists of 1465 firms and corresponds to the number of large Spanish firms that appear in the Dun & Bradstreet database for the year 2007. These large firms have over 250 employees and an annual turnover of more than 40 million Euros.

In 182 cases, we were unable to contact any managers that would answer our questionnaire, and thus made contact with 1,283 firms via electronic mail or telephone. 96 of these firms (7.5%) declared themselves unwilling to collaborate in the study. Therefore, 1,187 questionnaires were sent out, 1,078 via an e-mail that contained a link to a webpage for this purpose and 109 by fax. 167 valid questionnaires were received

(134 via e-mail on the webpage and another 33 in *Word* format via fax), which implies a sound rate of reply with regard to the total number of questionnaires sent out (14.1%). Table 2 shows the technical datasheet for the research.

Table 2
Technical datasheet for the empirical research

Population and range of the research	1,465 Spanish firms with over 250 employees and an annual turnover of more than 40 million Euros.
Size of the sample	167 firms
Confidence level	95%
Sample error	+/- 7%
Sampling procedure	Convenience sampling ⁴
Geographical area	All Spanish territory
Sample unit	Firm
Dates the fieldwork was carried out	March-June, 2007
Type of interview	Structured questionnaire in web format or in Word, at the choice of the interviewee. The questionnaire was sent to the firm CEO or, where this was not possible, to the Quality Manager or someone with a similar role.

Out of the questions that make up the questionnaire for the research, (table 3), questions Q2, Q4 and Q7 are aimed at the ontological support of the individual and his/her practices. Questions Q1 and Q6 refer to groups and their activities and practices as a support for knowledge. Questions Q3, Q5 and Q8 correspond to the organization as a basis for the creation and diffusion of knowledge, at all levels, and in all areas and ways of acting. Finally, question Q9 is aimed at discovering whether there is a strong link between individual and group.

Table 3
Research questionnaire Questions

Q1	Improvements in practices or innovations that occur in the firm are a result, above all, of work in groups..
Q2	The firm frequently experiments with new practices and ideas that arise as a consequence of individual work.
Q3	Within the firm, there are procedures for gathering different proposals, validating them and distributing them internally.
Q4	Information and know-how is shared through the relationships between individuals' tasks.
Q5	When new knowledge or know-how is diffused throughout the organization, this is a consequence of the actions of managers and employees at all levels of the organization.
Q6	New practices and ideas are often experimented within work in groups.
Q7	Individuals generate new information and know-how via the relationships and interaction among practices.
Q8	The organization establishes policies and ways of managing that foster knowledge creation further than any boundary pertaining to groups, areas or organizational levels.
Q9	Work organized in groups enables new ideas and practices to appear that arise from individual experience and work.

B. Data Analysis

The study of which are the ontological supports upon which the creation and/or diffusion of knowledge takes place consists, firstly, of obtaining satisfactory value for the Cronbach alpha. The value obtained was 0.729, which is satisfactory for the internal consistency of the questions asked. Secondly, by applying the principal components method, an exploratory factor analysis is obtained that indicates which are the ontological dimensions or supports of knowledge. Finally, a confirmatory factor analysis is applied, estimating the parameters via the maximum likelihood method

The exploratory factor analysis identifies two ontological dimensions (table 4), with acceptable values both for the KMO index (0.801) and for the Bartlett sphericity test (associated p-value < 0.05). Only the items with a score of over 0.60 in the rotated component matrix are considered for the formation of the dimensions, and we have followed the criteria that the values themselves should be greater than one. The total explained variance is 62.98% (table 4).

In order to obtain the values indicated for the KMO and Bartlett sphericity test, the variables corresponding to P2 and P4 were removed.

Table 4
Ontological supports or dimensions of knowledge

Exploratory factor analysis	Dimension 1	Dimension 2
Q1	0.693	0.228
Q3	0.120	0.888
Q6	0.805	0.171
Q7	0.738	0.203
Q9	0.735	0.175
Q5	0.234	0.840
Q8	0.288	0.632

Bartlett sphericity test = 340.24 (p-value < 0,00)
Kaiser-Meyer-Olkin Index (KMO) = 0.801

Once the number of dimensions had been determined and having observed the composition of their factor loadings, these were *ontological individual-group support for knowledge* for dimension 1, and *organizational (and institutional) ontological support for knowledge* for dimension 2. Dimension 1 explains 33.76% of the variance and confirms hypothesis 2. Dimension 2 explains 29.22% of the variance and confirms hypothesis 3.

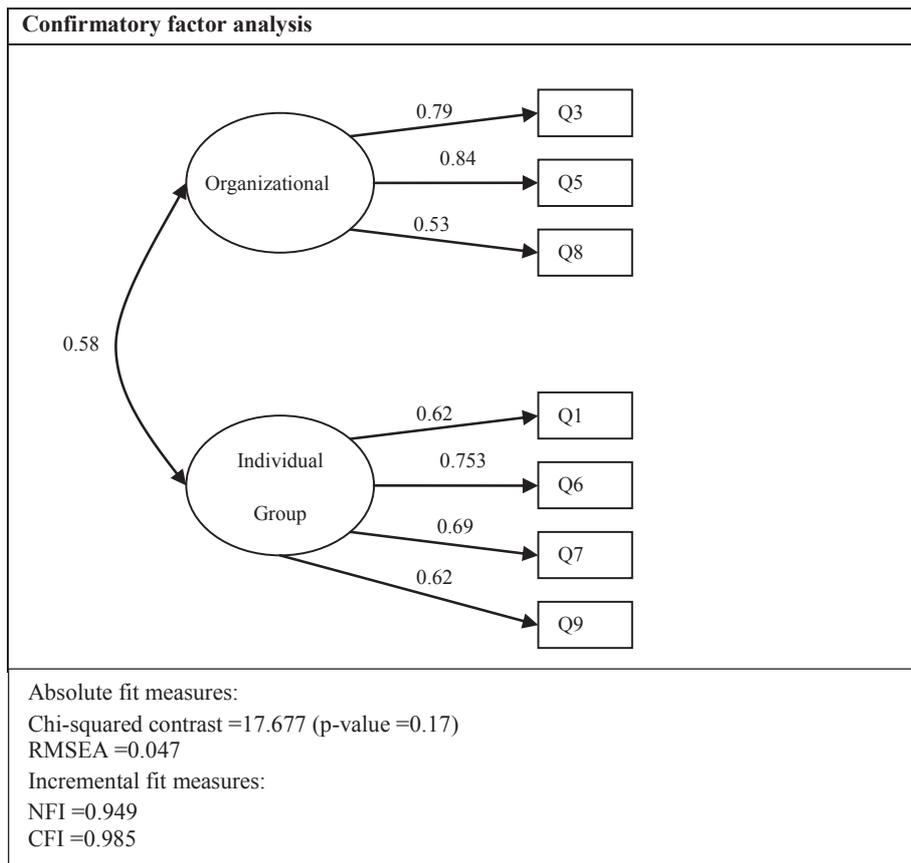
In the consistency analysis of each of the dimensions, a value of 0.766 was obtained for the first dimension and 0.756 for the second. According to Hair *et al.* (1998) the results obtained do not pose any type of problem in terms of internal consistency.

Figure 2 shows, as the final step in the empirical study, a confirmatory factor analysis applied to the results of the previous one. The estimation of parameters is again based on the maximum likelihood method.

It can be observed that all the coefficients from the structural model reach values of over 0.5, which is the minimum value recommended (Hair *et al.*, 1998), and they all statistically vary from zero with a 95% level of significance.

The results of the fit are acceptable (Hair *et al.*, 1998). The values for NFI, CFI and IFI are close to one. The root mean square error of approximation (RMSEA) shows a value close to zero and the p-value associated with the chi-square contrast is greater than 0.05. It can thus be concluded that the sample has a good fit with the proposed model of two factors or two *ontological supports for knowledge*.

Figure 2
Value of the standardized estimated parameters



V. DISCUSSION OF THE RESULTS AND CONCLUSIONS OF THE STUDY

The empirical research allows us to establish which dimensions are the *ontological supports* for the sample of large Spanish firms examined. Between the proposal of Crossan, Lane and White (1999), who suggest individual, group and organizational levels of knowledge support and that of Nonaka and Takeuchi (1995) who propose individual-group and organizational levels, the study inclines more towards the latter.

The exploratory factor analysis groups questions Q1 and Q6, which refer to the creation of knowledge in groups, into a single factor, along with question Q7, based on the contributions to information and know-how as a result of individual actions, and Q9, which relates groups and individuals in knowledge creation. This evidently corresponds to the *individual-group ontological support* for knowledge. Questions Q3, Q5 and Q8 are grouped together in the other factor, which deals with *ontological organizational or institutional support*.

Thus is the result of the empirical study, in which the close relationship between practice and knowledge creation (Spender, 2008) and team technologies (Alchian and Demsetz, 1972), lead to joint forms of production and knowledge creation in the different areas of the firm.

For Nonaka and Takeuchi (1995) and for Nonaka in general (Nonaka, 1994; Nonaka, Toyama and Konno, 2001), practice, and the conditions of an organizational context that stimulate adequate involvement and behavior (the concept of “Ba”) highlight the importance of ontological support, pointing out the interactions between the individual-group level of support of knowledge and organizational support. However, the cognitive approach to which these authors belong means that *conception of the context in which practice occurs* stays within the framework of social and institutional relationships.

In this sense, and as a theoretical contribution of this article, our repeated allusions to the physical, technical and social reality as an ontological support of knowledge transcend the organizational context and the strict framework of social relationships. The nature of materials and the simplicity or complexity of the technology used (Perrow, 1967), broaden the contextual conditions of knowledge to the physical and technical characteristics of work (operational or managerial); and this opens up a stream of research that should be incorporated into the agenda of knowledge management.

Tsoukas (1996) and Spender (1996, 2007, 2008) come close to the line of research proposed but a more explicit recognition of the importance of the physical and technological context is required (engineering, sociology, and economy). This implies, as always happens with innovation, breaking down boundaries, extending the field of knowledge management to how knowledge is produced in relation to materials, different technologies, the social context and behavior. If practice is, in effect, an essential issue for the formation of knowledge, what we are proposing is indispensable.

In future studies along these lines, we will attempt to advance along this road, which has now become a proposal for knowledge management.

ENDNOTES

1. Nonaka and Takeuchi (1995), also refer to interorganizational knowledge.
2. In the words of Spender (2008: 162) “The naive presume knowledge is a ‘cognition’ or mental representation of reality, and bad or false knowledge is that which is inconsistent with ‘the facts’ of reality. The underlying assumption is that we can check the quality of this knowledge directly against the ‘facts’, against the reality represented.”
3. Innovative firms, Readers in their sectors, bring about change; less advanced firms, which survive by imitating leader firms, adapt to these changes.
4. We thus call the formation of the sample via the sample units that were accessible (or that answered the questionnaire).

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