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Knowledge management in 10 Colombian companies: an intertwined multiple case study based on the Nonaka-Takeuchi model

Gestión del conocimiento en 10 empresas colombianas siguiendo el modelo Nonaka
y Takeuchi: estudio de casos múltiples entrelazados

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Abstract

The Knowledge Management (KM) process is presented through the three components of the Nonaka-Takeuchi theory, using the methodology of intertwined multiple case studies on a sample of 10 Colombian companies: Five Large Businesses (LBs) and Five Small and Medium-sized Businesses (SMBs). The objective was to determine the

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level of KM and compare both sample groups, based on the three components of the theory: the four modes (4MDs), five conditions (5CDs), and five phases (5PSs). The main findings show that, in the 4MDs of converting knowledge from tacit to explicit, the five SMBs scored higher than the five LBs. Likewise, the results show that the 10 businesses carry out the necessary KM actions to prevent created knowledge from easily disappearing over time. Finally, the study found, based on the analysis of the knowledge spiral, that the five SMBs manage knowledge more in line with the theory than the five LBs.

Keywords: knowledge management;
Large businesses; SMBs; Knowledge spiral;
Multiple cases; Nonaka and Takeuchi.

Resumen

Se presenta el proceso de Gestión del Conocimiento (GC) a través de los tres componentes de la teoría de Nonaka Takeuchi, basados en una muestra de 10 casos de estudio múltiples entrelazados en cinco grandes empresas y cinco empresas Pymes colombianas. El objetivo es determinar el nivel de GC y establecer un comparativo entre ambos grupos, a partir de los tres componentes de la teoría: las cuatro formas (4FM), cinco condiciones (5CD) y cinco fases (5FS). Los principales hallazgos muestran que, en las cuatro formas de convertir el conocimiento de tácito a explícito, las cinco Pymes tienen calificaciones más altas que las cinco grandes empresas. Los resultados también arrojan actividades de GC en los diez casos, necesarias para que el conocimiento creado no desaparezca con facilidad. Finalmente, la investigación concluye que el análisis de la espiral del conocimiento se inclina a que las 5 pymes gestionan el conocimiento de forma más acorde con la teoría, en comparación con las 5 grandes empresas.

Palabras Clave: Gestión del conocimiento; Grandes empresas; Pymes; Espiral del conocimiento; Casos múltiples; Nonaka y Takeuchi.

1. Introduction

Knowledge Management (KM) has widely encouraged researchers to use the developed models for solving specific problems involving the organizations' personnel that directly participates in the processes (Blanchard, 2002). This entails the analysis, based on the knowledge spiral (Nonaka and Takeuchi, 1995), of situations that can prove the use of KM with the purpose of verifying the implementation of this type of processes in companies. Consequently, in this research, we analyzed 10 cases of KM aiming at answering the research question: To what

extent do the businesses under study apply the four modes (4MDs), the five conditions (5CDs), and the five phases (5PSs) of the Nonaka-Takeuchi theory?

In 1950, Michael Polanyi suggested the existence of two types of knowledge: explicit and tacit (Pérez-Fuillerat *et al.*, 2018), which were later used by Nonaka and Takeuchi (1995) to explain how organizations create and manage knowledge. They proposed three components for KM: the 4MDs to convert tacit knowledge to explicit knowledge, the 5CDs that favor the knowledge spiral in organizations, and the 5PSs of the knowledge-creation process.

This paper is organized as follows. The first section presents the literature review on the characteristics of the KM models; particularly, it describes the characteristics of the spiral model developed by Nonaka and Takeuchi (1995) and the three components (4MDs, 5CDs, 5PSs) proposed by them. The methodology used to analyze intertwined multiple cases is outlined in the second section, as well as the cases, the sample definition, and the data collection and processing. The final section shows the results, the discussion, and the practical applications in the business world; it also includes some limitations, future research proposals, and a conclusion.

2. Knowledge management

(Tari and García, 2009) outlined three concepts from which different aspects of KM has been studied: organizational learning (OL), Organizational Knowledge (OK), and Learning Organization (LO).

In this respect, Cardona and Escobar (2012) indicated that OL favors the absorption and exploration of knowledge from the environment. Likewise, Kitapçı and Çelik (2014) defined OL as the ability to develop new knowledge and improve existing knowledge. For their part, Serinkan *et al.* (2014) conceptualized OL as an iterative and dynamic process that occurs when new knowledge is assimilated and put to use (feedback), thus improving intellectual capacity and knowledge transfer in all members of a company. In this regard,

Sepúlveda-Rivillas *et al.* (2022) emphasized the importance of strengthening the relationship between intellectual capital and KM, as this has an impact on the development of companies.

From a different perspective, OL capabilities have been studied in terms of the mechanisms of knowledge capture, storage, interpretation, transfer, creation, and assessment (Kitapçı and Çelik, 2014). Other authors such as Zapata-Cantú *et al.* (2019) have stated that KM will have a greater impact on organizations if human resources are understood as creators of knowledge and are allowed to have better interactions by means of information technology.

Parra (2004) identified philosophical, scientific, and knowledge-engineering perspectives in KM. The philosophical perspective covers two trends: rationalism and empiricism. In 1960, philosophers Karl Popper and Michael Polanyi approached knowledge to the business field by introducing a conceptual framework with the categories of explicit knowledge and tacit knowledge.

From the scientific point of view, questioning nature is essential to understand the phenomena and how they are related (Parra, 2004). In engineering, knowledge is understood as an object that can be manipulated, processed, and disseminated for decision-making. Finally, Huerta *et al.* (2004), from the perspective of the company as a social organism, reported that organizations develop unique knowledge and skills that enable them to survive in the market.

In the same way, Drucker (1993) emphasized that, in LOs, knowledge must be productive and applied to the development of new products, services, and business models; just as Zapata-Cantú *et al.* (2019) suggested that KM allows organizations to develop better products and services. Xu *et al.* (2010) reinforced this notion by saying that managing new or modified ideas and including KM in innovation management processes are necessary actions.

Zapata (2004) and Bueno (2004) explained four key attributes for knowledge transfer within organizations: codification, teachability, uncertainty, and complexity. In this regard, Argote and Miron-Spektor (2011)

and Zapata-Cantú *et al.* (2019) pointed out that personnel should be trained to develop the ability to disseminate and share knowledge among all members of the organization. According to Lenis (2015), the attribute for knowledge transfer is teachability, which requires knowledge codification. What is taught belongs to the individual and it is not passed on to the organization as know-how of procedures that promote the management of organizational innovation.

For Kogut and Zander (2003), Segarra-Ciprés and Bou-Llusar (2004), and (Heiman and Nickerson, 2004), the complexity of knowledge appears when it is transferred, as in the case of unintelligible models that are represented in multiple competences and are difficult to understand and apply. In this sense, it is relevant to underline the importance of managing intangible knowledge to organizations (Sepúlveda-Rivillas *et al.* 2022), which favors the reconfiguration of KM practices and their impact on the people in charge of them.

This paper focuses on addressing KM based on the Nonaka-Takeuchi theory from an OK approach that could be incorporated in Western organizations (López *et al.*, 2005). In all respects, tacit knowledge is one of the strengths that organizations should manage as an element of growth and development (Lozano-Ramirez, 2022).

3. The Nonaka-Takeuchi's model

The knowledge spiral theory, as a justified true belief (Nonaka and Takeuchi, 1995), develops three components: the 4MDs to convert tacit knowledge to explicit knowledge, the 5CDs that favor the knowledge spiral in organizations, and the 5PSs of the knowledge-creation process (Table 1).

Knowledge develops through the 4MDs within organizations as a living organism, facilitating the conversion of knowledge from tacit to explicit (T-E) (Nonaka and Takeuchi, 2021) as part of the cognitive structures that make up the organizational culture (Pinto-Jiménez, 2007).

The first mode (MD1) is socialization, which corresponds to the process that allows individuals to transfer knowledge from

Table 1. Process of KM analysis

Four modes of knowledge conversion	Five conditions to be met by the organization	Five phases of the knowledge-creation process
MD1. Socialization: T-T	CD1. Explicit intention	PS1. Sharing tacit knowledge
MD2. Externalization: T-E	CD2. Autonomy	PS2. Creating concepts
MD3. Combination: E-E	CD3. Fluctuation and creative chaos	PS3. Justifying concepts
MD4. Internalization: E-T	CD4. Redundancy	PS4. Building an archetype
	CD5. Requisite variety	PS5. Cross-leveling of knowledge

Source: Nonaka and Takeuchi (1995).

tacit to tacit (T-T) through actions in which experiences are shared, such as mental models and technical skills.

In the second mode (MD2), externalization, tacit knowledge is converted to explicit knowledge (T-E) (Bandera *et al.*, 2017) by means of dialogue or collective reflection (Nonaka and Takeuchi, 1995); knowledge is reflected in metaphors, analogies, concepts, hypotheses, or models.

Through the Third Mode (MD3), combination, knowledge is transferred from Explicit to Explicit (E-E) (Lindströma *et al.*, 2015); individuals exchange and combine knowledge (Nonaka and Takeuchi, 2016) using various means such as documents, meetings, conversations, or networks.

Lastly, the Fourth Mode (MD4) is internalization, which is used to convert knowledge from Explicit to Tacit (E-T) thanks to “learning-by-doing” strategies; new knowledge is incorporated into the know-how and the organizational culture and it becomes generalized in documents, manuals, or oral stories (Bandera *et al.*, 2017).

For the knowledge spiral process to take place, the 5CDs need to be met. The first Condition (CD1) consists of an explicit intention (Nonaka and Takeuchi, 1995) by managers to support employees (Bandera *et al.*, 2017).

The Second Condition (CD2) refers to the autonomy of employees to act in the creation of knowledge; autonomous individuals interact and are open to share knowledge (Nonaka *et al.*, 2016), thus generating organizational autopoiesis (Nonaka and Takeuchi, 1995).

As a Third Condition (CD3), fluctuation and creative chaos should be permitted as they stimulate the interaction with the environment and the search for changes from the current situation (Lindströma *et al.*, 2015); moreover, employees should be allowed to find solutions beyond those previously established.

The Fourth Condition (CD4) is redundancy, an intentional overlapping of information, which enables tacit knowledge to emerge and permeate all areas (Nonaka and Takeuchi, 1995).

Ultimately, the Fifth Condition (CD5) is requisite variety; within organizations, this condition is articulated with the complexity of the environment (Nonaka and Takeuchi, 1995) to give way to responses to the challenges posed by the same environment (Nonaka and Takeuchi, 2021), given the rapid access to information (Nonaka *et al.*, 2016).

The third component of the theory by Nonaka and Takeuchi (1995) is the 5PSs of the knowledge-creation spiral process that is reproduced permanently (Bandera *et al.*, 2017). The First Phase (PS1) consists of spontaneously sharing tacit knowledge with the task force, experiencing the redundancy of information and sharing organizational intention; self-organizing teams are open to creative chaos and interact with the environment (Nonaka and Takeuchi, 1995).

Creating concepts is the Second Phase (PS2), in which deduction, induction, and abduction (metaphors and analogies) are used through continuous and qualified dialogue (Nonaka *et al.*, 2016), leading to the creation of concepts towards a shared mental model (Lindströma *et al.*, 2015).

Table 2. General data about the cases

Cases	Large businesses					Small and medium-sized businesses				
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10
Owner	Family	Public	Public	Ltd.	Public	Family	Family	Ltd.	Family	Family
Size	LB	LB	LB	LB	LB	MB	SB	SB	MB	SB
Years in the market	72	45	42	82	32	23	14	16	23	15
Sector	Trans. goods	Hospit.	Indust.	Insura.	Indust.	Trans. goods	Trans. persons	Indust.	Indust.	Adverti.

Conventions: LB = large business, MB = medium business, SB = small business.

Source: Authors' own elaboration.

Justifying concepts is the Third Phase (PS3), where the validity of the concepts created is determined by screening the information (using qualitative and quantitative criteria); the reference is the organizational intention, ensuring the value systems or societal needs (Nonaka and Takeuchi, 1995).

In the Fourth Phase (PS4), building an archetype, the aim is to create a prototype that can be a design, a product, a mechanism, or a model (Nonaka and Takeuchi, 1995); this phase combines created explicit knowledge with existing explicit knowledge and involves different areas (Nonaka *et al.*, 2016).

Finally, the Fifth Phase (PS5), cross-leveling of knowledge, is an interactive and spiral process (Nonaka and Takeuchi, 1995), in which a new cycle of the knowledge spiral begins, either in other areas of the organization or subsidiaries (i.e., intra-organizationally) or in customers, suppliers, or competitors (i.e., extra-organizationally) (Nonaka and Takeuchi, 2021). The spiral model moves to new cycles at different ontological levels with applications for the creation of new knowledge (Nonaka *et al.*, 2016).

With the purpose of specifying the factors for the analysis of the 10 cases studied, Table 1 summarizes the 4MDs of knowledge conversion, the 5CDs that the organization must fulfill, and the 5PSs of knowledge creation.

4. Materials and methods

This intertwined multiple case study

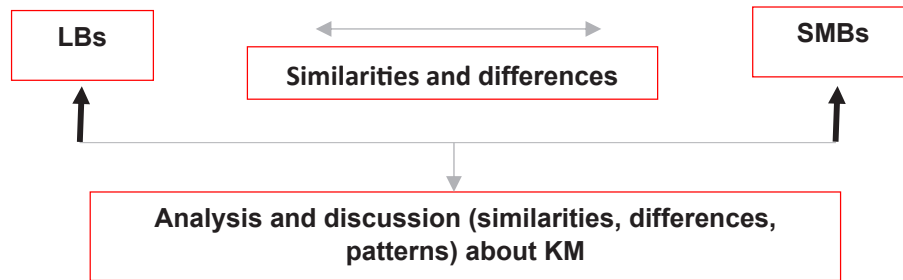
(Hernández Sampieri *et al.*, 2014) applied the model proposed by Nonaka and Takeuchi (1995) (Table 1) from a qualitative and quantitative approach. A series of individual cases provides the data to analyze differences and similarities, according to the research question.

The selection of multiple cases constitutes a set of varied experiments; each case or experiment aims to examine a complementary aspect of the research question. Consequently, the sample comprises 10 cases that were selected following the recommendation by Yin (2012) and Eisenhardt (1989), who claim that data resulting from multiple cases can provide greater confidence in the findings and that, "while there is no ideal number of cases, a number between four and 10 usually works well. With fewer than four cases, it is often difficult to generate theory with much complexity, and its empirical grounding is likely to be unconvincing."

Case study research is used to create theoretical constructs or propositions from case-based empirical evidence. The case is used as the base unit of analysis to formulate theory inductively. Theory emerges from the case and is developed by recognizing patterns of relationships between constructs (Figure 1) within one case or among cases (Eisenhardt and Graebner, 2007).

5. Data collection

The 10 selected cases (units of analysis) met the following criteria (Table 2). 1. Five cases had to be large businesses (LBs) and the other five had to be small and medium-sized

Figure 1. Conceptual Model of the Research

Source: Authors' own elaboration.

businesses (SMBs or SBs), according to the definition of this term provided by the Ministerio de Industria, Comercio y Turismo, Colombia (Colombian Ministry of Commerce, Industry, and Tourism) (2019). 2) They had to be geographically located in the same territory, in this case, Colombia, specifically, the metropolitan area of Medellín. 3) The selected businesses had to be incorporated for at least 10 years.

According to Yin (2004) and Stake (1998), we triangulated the information, i.e., we used primary and secondary sources related to the process. Concerning primary sources, we applied instruments and collected data from the businesses to document the report on the process and results. As for secondary sources, we used corporate reports and our assessments, as we measured the reports using a Likert scale based on the Nonaka-Takeuchi model (Table 3).

We carried out a one-to-two-hour in-depth interview with each founding partner of the business in order to collect the data and share information about the research project and the expected results. Subsequently, we made three additional visits to conduct interviews with the manager and other company officers (designated by the manager), apply instruments, and gather additional information, all within a period of five years. We recorded the interviews and then thoroughly transcribed them because they contained key aspects related to KM of each organization. In the 10 cases, an action plan in KM processes was designed, the planned process was implemented, and evidence on the results of the process was collected.

6. Data processing

The literature review provided the dimensions and variables for measuring KM based on the Nonaka-Takeuchi model (Table 1). We analyzed the information in the following way. First, we characterized the cases; then, we described the KM process and established differences and similarities between LBs and SMBs for each case; and, lastly, we analyzed and discussed the results to identify KM patterns in the cases studied (Yin, 2012; Hernández Sampieri *et al.*, 2014). Figure 1 shows the diagram used for analyzing the data.

7. Results

In this section, we analyze the results based on the structure of the knowledge-spiral model by Nonaka and Takeuchi (1995) (Table 1) to identify KM in the 10 cases. We begin by characterizing the 10 cases (Table 2); secondly, we describe the KM process (Table 4); thirdly, we highlight the differences and similarities between LBs and SBs with regard to KM; and we finish by including the comparative report.

7.1. Characterization of the cases under study

To characterize the cases, we described some variables (Table 2) of the businesses where the KM activity was carried out.

In all cases, some of the areas were intervened with the participation of different levels within the organization. The starting point was always a situation conceived as

Table 3. KM rating based on the Nonaka-Takeuchi theory

9,467 mm	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10
FACTORS	LB1	LB2	LB3	LB4	LB5	MB SMB	SB SMB	SB SMB	MB SMB	SB SMB
MD1	4.50	4.25	3.75	4.50	5.00	5.00	4.50	4.50	4.50	4.75
MD2	4.00	4.00	4.00	4.50	5.00	4.75	4.50	4.25	4.50	4.50
MD3	4.25	4.25	4.00	5.00	5.00	4.75	4.75	4.25	4.50	4.75
MD4	3.25	2.75	3.00	4.75	4.75	4.75	4.00	3.50	3.00	3.75
CD1	4.75	4.25	4.25	5.00	5.00	5.00	4.75	5.00	3.75	4.75
CD2	4.50	3.50	3.50	5.00	5.00	5.00	4.75	4.25	4.00	4.50
CD3	4.50	2.75	4.00	4.75	4.75	4.75	4.50	3.25	2.75	4.50
CD4	3.75	2.50	3.25	4.75	4.75	5.00	4.75	3.50	1.75	3.00
CD5	3.75	2.75	3.50	4.75	4.75	5.00	4.75	3.25	2.00	3.25
PS 1	4.50	4.00	4.75	5.00	4.75	5.00	4.75	4.00	3.50	4.75
PS 2	4.00	4.00	4.75	4.50	5.00	5.00	4.75	4.25	2.75	4.75
PS 3	4.25	4.00	4.50	4.00	5.00	5.00	5.00	4.00	2.75	4.00
PS 4	4.00	1.75	2.75	3.50	4.75	4.75	4.75	3.25	2.00	4.00
PS 5	4.00	1.25	2.75	2.50	5.00	5.00	4.75	3.25	1.50	3.25

Note: The rating system uses the following scale: 5= strongly agree, 4= agree, 3= neither agree nor disagree, 2= disagree, 1= strongly disagree (Palacios Marqués and José Garrigós Simón, 2006; Durango Yepes and Quirós Carvajal, 2017). The letters in the cases have the following meaning: LB= large business, MB= medium-sized business, SB= small business, SMB= small or medium-sized business.

The colors have been adopted from the SIGET-PROS management model, developed by researchers at Institución Universitaria de Envigado. In the model, blue is used for scores above 80%; green, for scores between 60% and 79%; yellow, for scores between 40% and 59%; and red, for scores below 40%.

Source: Authors' own elaboration.

an opportunity for improvement, for which a transformation proposal was designed and implemented, according to the possibilities described in Table 4.

All cases presented intervention processes carried out between 2015 and 2020 (before the COVID-19 pandemic). In the five LB cases, the proposal was designed and developed by an assistant from one of the areas, together with a consultant external to the company. In the five SB cases, a team of experts designed and supported the implementation of the project.

Of the LB cases, four are owned by economic groups (except for Case 1, which is a family-owned business) and all have been in the market for more than 30 years. Of the SB cases, four are family businesses (except for Case 8) and all have been in the market for more than 10 years.

In general terms, four cases (two LBs and two SBs) belong to the industrial sector and six cases belong to the service sector: one LB and two SBs, to the transportation subsector; one LB, to the hospitality subsector; one LB, to the insurance subsector; and one SB, to the advertising subsector.

Five cases (four LBs and one SB) developed KM proposals in the area of human resource management; two cases (one LB and one SB), in the area of logistics; other two cases (one LB and one SB), by integrating KM projects in all areas; and one SB case, in the financial area.

All cases required operational-level processes in the projects; two cases (one LB and one SB) included tactical-level processes; and other two cases (one LB and one SB) applied strategic level-processes.

Table 4. Description of KM in the business cases

Cases	KM activity description	Levels of participation
Case 1	<p>In 2018, an employee from the assistance level identified the need to guarantee a better service to customers, who stated that the operational staff, with whom they had greater contact, was unaware of the information required. This situation arose during lunch hours, and then led to a proposal to the delivery coordinator.</p> <p>The project focused on designing a reorientation training plan with the operational staff. The human resource department consulted with management, which approved the plan and issued the guidelines. Within four months, the business developed and implemented the proposal in the stocking plant. Subsequently, the company validated the results and applied the plan to other areas.</p>	<p>Operational Tactical Strategic</p>
Case 2	<p>Inventory inconsistencies were frequent. An assistant in the supply area reported the issue to his supervisor. In 2018, this assistant proposed the implementation of an automatic control of inputs and outputs, which was to be updated in real time. The head of the department authorized the development of the design.</p> <p>The proposal was built including its corresponding investment plan. It was submitted to management, but was not approved at the time, since it had to be presented to the project area of the entire organization, with the purpose of evaluating its articulation with the company's policies. The project was shelved.</p>	<p>Operational Tactical</p>
Case 3	<p>In 2016, the quality laboratory had a challenge arising from institutional customer complaints; returns and claims were being filed for over 7% of the cases being sold for all references.</p> <p>The production assistant identified the situation, brought it to the area committee, and undertook to implement an innovative management model* with the participation of the entire laboratory team. The diagnosis was conducted, and the critical points were identified; subsequently, the transformation proposals were designed and implemented, reducing rejects to 2% of production. The head of the production area submitted the proposal to the company's management, with a view to implementing this methodology in other areas, but this was not approved.</p>	<p>Operational Tactical</p>
Case 4	<p>In 2017, the human management area had a plan for the use of free time for recreational, cultural, and sports activities. But some employees did not feel motivated.</p> <p>The management discussed these concerns and proposed new ways of using time for recreation. New ideas were gathered, and a plan of action was drawn up and presented to the human resource management department. The proposal was implemented within two months and the participatory methodology was accepted as the strategy to be prioritized for future designs of activities throughout the organization.</p>	<p>Operational Tactical Strategic</p>
Case 5	<p>In 2018, supervisors reported complaints to the human resource area about deficiencies in onboarding. In view of these complaints, the human resource assistant proposed to include training time in the specific processes of the area for which the new employees were being hired.</p> <p>A plan was designed, and in two months, its implementation was launched. The evaluation of results indicated major achievements, which led to a proposal to the national management to create a new position within the company. The model was replicated in other cities.</p>	<p>Operational Tactical Strategic</p>
Case 6	<p>The year 2015 was special because of the dynamics of expansion of the direct sales model where the company had its main customers. The company's managers agreed to implement an innovative management model*. The diagnosis revealed a potential crisis, which required an urgent action plan.</p> <p>Leaders from all levels and areas participated in the design and implementation of a long- and medium-term action plan. In 2016, the results of implementation of this model were assessed, achievements were identified, and the required adjustments were made.</p>	<p>Operational Tactical Strategic</p>
Case 7	<p>After a crisis in 2015, the business required an in-depth intervention. In 2017, a corporate transformation plan was designed.</p> <p>The management team approved the implementation of an innovative management model* aimed at designing a restructuring of the organization. The strategic business units were identified, and an action plan was designed with the participation of all areas. The plan was implemented and had an impact in all areas.</p>	<p>Operational Tactical Strategic</p>

Case 8	In 2015, a structured plan was needed to continue the upgrading process. The manager proposed to the board of directors the design and implementation of an action plan, which were approved without objection. The plan was carried out with the participation of an advisory team and all the organization's staff. The project was implemented with the collaboration of some suppliers, who helped to achieve the transformation in the production area.	Operational Tactical Strategic
Case 9	In 2015, an analysis conducted revealed the need for an intervention in the production area, where some risks were identified. Although the evidence was clear and some people from different areas provided information about the failures, the director of the area did not agree. In 2016, an accident involving chemical vapors led to interventions by external authorities; an action plan was then implemented, which resulted in drastic changes in the area.	Operational Strategic
Case 10	In 2015, an external diagnosis indicated management failures that were affecting production. After listening to operators in the production area and employees from other areas, the management made profound changes. This connection between the strategic area and the operators made it possible to design a new action plan that gave the company a boost. The result was a better environment throughout the organization, improved production, and increased sales.	Operational Strategic
The innovative model* mentioned in Cases 6 and 7 is a model called SIGET-PROS, developed by researchers at Institución Universitaria de Envigado. This innovation is in the process of registration; therefore, the information in this regard is not disclosed.		
Source: Authors' own elaboration.		

7.2. Knowledge management in the cases under study

As it was mentioned above, the study focused on the KM projects set up in 10 businesses. Table 4 describes the actions carried out in each case.

7.3. Differences and similarities between LBs and SBs regarding KM

For the analysis of each case, we described the KM process in each organization. In addition, we applied a Likert scale to assess the application of each element of the analysis process. Table 3 shows our rating based on the conceptualizations proposed by Nonaka and Takeuchi (1995).

7.4. Relevant data

Considering that the intertwined multiple case study had a qualitative and quantitative approach and was based on the concept of OK proposed by Nonaka and Takeuchi, in this section, we present block analyses for the three components both in the LB and SB cases.

Concerning the 4MDs in the LB cases, the highest score was for MD3, which combines new explicit knowledge with existing explicit knowledge; while the lowest value was found in MD4, where the internalization of explicit

knowledge to tacit knowledge takes place. In the five LB cases, MD2 (externalization of tacit knowledge to explicit knowledge) showed a similar score; however, Case 5 stood out.

Regarding the 5CDs that the LB cases must meet, CD1, which represents the explicit intention of KM, obtained the highest rating, while CD5 received the lowest score showing non-compliance with KM requirements. In this component, Case 2 scored the lowest.

As for the 5PSs in the LB cases, there were very similar values in all cases for PS1, PS2, and PS3. This similarity starkly contrasted to the very low rating in PS4 and PS5 related to the difficulty of building prototypes of processes or products and expanding knowledge to the external environment.

In this block analysis of the LB cases, Case 5 stood out as it scored above 4.75 in all the MDs, CDs, and PSs. In contrast, Case 2 presented many critical factors below 3.0 (MD4, CD3, CD4, CD5, PS4, and PS5).

Moving on to the block analysis of the SB cases, MD1, MD2, and MD3 were homogeneous in the five cases, as they all scored above 4.25, proving the existence of an effective KM (T-T, T-E, E-E).

With respect to the 5CDs in the five SB cases, the highest scores were in CD1, for the explicit intention of KM in the different

processes. CD3, CD4, and CD5 presented lower values due to the slow ability to creatively face problems and respond to the challenges of the environment. In this sense, Case 9 was the most critical, since it scored less than 3.0.

Lastly, regarding the 5PSs in the SB cases, PS1 and PS2 were very even in the five cases (4.3 on average). The lowest ratings were in PS4 and PS5 because the archetypes built slowed down both the intra-organizational KM expansion to all areas and the extra-organizational KM expansion.

In this block analysis of the SB cases, Case 6 stood out as it reported the highest ratings between 4.75 and 5.0. In contrast, Case 9 scored below 3.0 in PS2, PS3, PS4, and PS5 (creating and justifying concepts) and in CD3, CD4, and CD5 (autonomy in facing chaos creatively and responding to the challenges of the environment).

As an overall analysis, Cases 4, 5, and 6 had a significant number of MDs, CDs, and PSs with ratings above 4.75. All factors of Cases 5, 6, and 7 had values above 4.0. Most MDs, CDs, and PSs scored above 4.0, similarly distributed between the LB cases (39 in total: 12 MDs, 12 CDs, 15 PSs) and the SB cases (39 in total: 16 MDs, 11 CDs; 12 PSs). Cases 5 and 6 scored above 4.75 in all the 4MDs, the 5CDs, and the 5PSs, resulting in the most successful cases of the study.

In PS5, three LB cases (Case 2, Case 3, and Case 4) were below 3.0, while only one SB case (Case 9) was below 3.0. Therefore, we can infer that, in SB cases, thanks to their size, expanding knowledge as an interactive process in the knowledge spiral is easier. Regarding PS4, the LB cases scored lower than the SB cases, since sharing explicit knowledge in the latter is easier because of the participation of the different areas of the company.

In the 4MDs of knowledge conversion (T-T, T-E, E-E, E-T), the five SB cases achieved higher values than the five LB cases. This means that KM in the SBs, due to their size, favors the formulation of theoretical constructs from empirical evidence, which are quickly recognized by most members of the organization.

8. Discussion

The objective of this comparative intertwined multiple case study based on the Nonaka-Takeuchi model was to contribute to the understanding of KM in Colombian LBs and SMBs and, thus, increase the theoretical body on the subject.

The findings (Table 5) suggest that, according to the 4MDs, the 5CDs, and the 5PSs of the Nonaka-Takeuchi model on KM, the studied SBs (Cases 6-10) manage knowledge in a better way than the LBs (Cases 1-5), although the differences are not widely significant (Table 4). Cases 6 and 7, obtained values above 4.0 in all factors; whereas Case 9, only in the 4MDs, received scores ranging between 3.0 and 4.5.

An adequate KM means that organizations properly use the 4MDs of knowledge conversion (T-E) (Cases 6 and 7); achieve the knowledge transfer through the sharing of experiences between external consultants and the team; externalize knowledge through collective reflection and dialogue sessions; combine the ways of sharing and reflecting on the various activities; and externalize knowledge in the know-how and by documenting and recording the good practices.

As regards the 5CDs and the 5PSs of KM in Cases 6 and 7, the management team became aware of the changes and accepted to introduce them, involved the business leaders, encouraged the autonomy of the collaborators to create knowledge, and favored the design of strategic plans.

The implementation of the innovative management model allowed the businesses to document the procedure, clarify concepts, and reach agreements. Additionally, they defined qualitative and quantitative assessment criteria and, ultimately, achieved the expansion of knowledge.

This finding is consistent with Harrington *et al.* (2019) and further supports their comparative study to identify the challenges of knowledge mobility between SMBs and multinationals. They concluded that one of the mechanisms for advanced knowledge transfer is establishing (in-person and virtual) networks and external trainings,

Table 5. Similarities and differences in the fulfillment of the factors in the 10 cases

Similarities and differences in LBs (Cases 1 to 5)	Similarities and differences in SMBs (Cases 6 to 10)
<p>It is worth highlighting that, in Case 5, all the factors scored above 4.0. In Case 3, seven factors scored below 4.0 (two MDs, three CDs, and two PSs). In Case 2, seven factors scored below 4.0 (one MD, four CDs, and two PSs); in fact, the two PSs scored below 2.0.</p> <p>Analyzing the groups of factors, Cases 4 and 5 stand out for achieving significant scores above 4.0 in the 4MDs of converting knowledge from tacit to explicit. Meanwhile, Cases 1 and 2 only reached MD3 (combination) and failed to achieve MD4 (internalization). Case 3 is exceptional because it did not achieve significant scores in MD1 and MD4, but it did develop MD2 and MD3.</p> <p>Cases 4 and 5 obtained significant scores above 4.0 in the 5CDs that need to be met for the knowledge spiral process to flow properly. Case 1 met the first three CDs.</p> <p>Regarding the 5PSs, only Case 5 successfully reached PS5. Case 1 also completed the 5PSs but obtained low scores in one MD and two CDs. Cases 2, 3, and 4 only reached PS3 (justifying concepts) and did not manage to complete PS4 (building an archetype or prototype) and PS5 (intra- and extra-organizational cross-leveling of knowledge).</p>	<p>Cases 6 and 7 scored above 4.0 in all the MDs, CDs, and PSs. In Case 8, six factors scored below 4.0 (one MD, three CDs, and two PSs). In Case 10, four factors obtained scores below 4.0 (one MD, two CDs, and one PS). For its part, in Case 9, only four factors achieved scores above 3.0 (three MDs and one CD).</p> <p>Analyzing the groups of factors, Cases 6 and 7 stand out for achieving significant scores above 4.0 in the 4MDs of converting knowledge from tacit to explicit. Meanwhile, Cases 8, 9, and 10 only reached MD3 (combination).</p> <p>Likewise, Cases 6 and 7 obtained significant scores above 4.75 in the 5CDs. Case 10 met the first three CDs, while Case 8 complied with the first two.</p> <p>As for the 5PSs, Cases 6 and 7 made it to PS5. Case 8 obtained scores above 4.0 in the first three PSs and Case 10, in the first four PSs. Finally, Case 9 did not develop any of the PSs and obtained scores below 3.5.</p>
Discussion of the comparative report	
<p>After analyzing each block of cases and comparing the five LBs with the five SBs, the following results were achieved: One LB (Case 5) and two SBs (Cases 6 and 7) achieved scores above 4.0 in all the factors assessed. Similarly, two LBs (Cases 4 and 5) and two SBs (Cases 6 and 7) achieved scores above 4.0 in the four MDs of converting knowledge from tacit to explicit. In addition, two LBs (Cases 4 and 5) and two SBs (Cases 6 and 7) obtained scores above 4.0 in the 5CDs. Moreover, one LB (Case 5) and two SBs (Cases 6 and 7) had high scores in the 5PSs of the knowledge-creation process. In MD4, lower scores (below 3.75) were found in six of the cases analyzed (1, 2, 3, 8, 9, and 10). Something similar occurred with CD4 and CD5 in the same cases. Finally, the same situation can be observed for these cases (except for Case 1) in PS4 and PS5.</p>	
<p>Source: Authors' own elaboration based on the analysis of the results in contrast with the factors of the Nonaka-Takeuchi's theory (1995).</p>	

since they lead to knowledge exchange.

Another finding is related to the 4MDs of converting knowledge in the 10 cases: the modes that stand out the most are MD2 (externalization) and MD3 (combination), which indicates that knowledge is converted from tacit to explicit and from explicit to explicit through collective dialogue and reflection, allowing employees to exchange and combine knowledge.

The application of these 4MDs in the 10 cases, within the framework of the management models and strategic plans, also suggests that the knowledge created will not disappear easily. Furthermore, provided that MD2 and MD3 are combined with PS1, PS2, and PS3 in nine of the 10 businesses (leaving

Case 9 out), there is evidence that KM will continue to be implemented throughout the organization.

In contrast, Plaza-Angulo (2018), in his study on knowledge creation in small establishments in Spain, indicated that actions related to tacit knowledge are more frequent, but there are no knowledge retention policies in the organizations to convert knowledge from tacit to explicit, which makes created knowledge more likely to be abandoned over time.

Similarly, in his comparative study on KM between Polish LBs and SMBs, Bolkunow (2019) concluded that SMBs spend little money and time to build and apply a KM system; therefore, knowledge is usually

transmitted orally. On the contrary, LBs create and implement organized systems to manage knowledge; in addition, they count on task forces that receive training and use procedures, documentary records, and information technology. Considering the overall rating for CD1 (Table 4), LBs have superior results, which demonstrates the explicit intention of KM by managers and employees and their commitment to it.

Unlike the results in the SB cases studied in Poland, the result for CD1 in our research is remarkable (except for Case 9), which suggests that the explicit intention and commitment should lead businesses to make the necessary investments to create a KM system. This fact is also reflected in the results: nine of the 10 cases implemented action plans and management systems that engaged all areas and required investments of both time and resources to successfully complete the process.

Another relevant finding in the 10 cases is that the practices leading to KM, which were adopted to create and transfer knowledge (Table 4) responded to managers' and employees' natural behaviors—and not to knowledge capture and creation plans. For example, in Case 1, an employee identified a flaw in customer service and, in conversations during mealtimes, a proposal emerged, which subsequently became a KM mode; in Case 4, the manager's assistant shared some dissatisfaction with his boss; in Case 5, in response to complaints, a human resource management assistant made a proposal; and, in Case 10, the business accepted the recommendations from an external party. In none of the cases KM was the result of a formal and planned process. This fits Cerchione and Esposito's (2017) finding: SMBs adopt KM practices from actions that focus on a KM process. We also found that the knowledge in SMBs is mainly integrated to the human resource management.

Finally, Marulanda *et al.* (2013) indicated that measurements should be performed periodically to obtain a real and effective diagnosis so that results serve as basis to other companies. For their part, Nyamrunda and Freeman (2021) proposed that, in view of the challenges and opportunities derived from the current pandemic, organizations with a measurable KM structure can have

access to a better overview that enables them to face and overcome different risk situations.

9. Practical implications

Initially, KM models were thought to be oriented mainly to scientific and technological development. Over time, models that centered on the development of innovation and management of organizational change—including that by Nonaka and Takeuchi (1995)—became more relevant. Companies that implement them are more profitable, grow faster, and are more productive (Dougherty, 2006). They also take a more flexible approach towards innovating, learning, and changing (Argyris, 1999).

As a result of the untimely effects caused by the pandemic, organizations are leaning towards models focused on social media and KM, as the learning capacity plays an important role in the development of organizational innovation (Bolívar, 1993; Senge, 1992).

10. Limitations, future research, and conclusion

The research findings contribute to nurture the literature on KM in LBs and SMBs; for their part, the limitations create research opportunities. Methodologically, we realized that, by adjusting the instruments (questionnaire and interview scripts), we can obtain more data and information to measure the impact of KM on value creation in companies.

A new explanatory case study—that carefully plans the dimensions and variables—can focus on the correlation between knowledge production and KM and the impact of knowledge on wealth creation.

We faced several challenges during fieldwork, which jeopardized the successful completion of the research. In one of the businesses, employees were dismissed, which generated tension in the research, but, at the same time, created the opportunity for a new topic of research related to knowledge creation and KM in family businesses. This future study could be aimed to establish whether the family propels the creation of

knowledge in the family business or becomes an obstacle to be overcome.

Another important topic has to do with determining whether Colombian LBs and SMBs have medium- and long-term knowledge retention policies or, on the contrary, as time goes by, the knowledge created is increasingly likely to be abandoned.

In conclusion, we identified no significant differences in the way knowledge is created and managed in LBs and SMBs, although the evidence leans towards SMBs having a more adequate form of KM (Table 3). Nine of the 10 cases started to perform KM actions; some undertook the implementation of a management model; and others developed action plans to create and manage knowledge.

This study shows the importance of taking KM measurements in organizations and disseminating the results because it makes companies, regardless of their size, more and more aware of the potential and advantages that detailed knowledge can bring to their sustainability.

The KM activities allowed companies to systematize their routines, which they considered to be good or excellent. The activities also allowed them to identify lessons learned that they could implement with the purpose of better managing and retaining human talent.

11. Conflict of interest

The authors declare no conflict of interest.

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