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Knowledge Management Maturity: Development of Maturity Scales and Interaction between Key Areas *

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Abstract:
Purpose: *The aim of this article is to analyze the interaction between key knowledge management (KM) maturity areas: Strategy, Culture, Technology and Knowledge Processes.*
Design/methodology/approach: *Structural equations by the partial least squares method were used to test the research model with survey data from 14 business units of a multinational food company which has its headquarter in Colombia.*
Findings: *The effect of the Strategy key area on culture is the highest in comparison with the rest of the relationships between key areas. There is also a positive and significant effect of strategy on technology but it is lower as compared to the effect on culture. By contrast, the direct effect of technology on knowledge processes is practically similar to culture.*
Practical implications: *The KM maturity model proposed is a complete and reliable KM diagnostic tool, both for subsidiaries to deploy KM strategies as well as for those that have certain experience in the area, which helps to fix a clear baseline to start improvement actions conductive to the highest maturity level.*
Originality/value: *The work breaks the tradition of proposing generic and generalist maturity models, by proposing a model that offers a detailed description of the maturity scale of each one of the variables making up the key areas, presenting also satisfactory reliability and validity indicators. Besides, it evidences that the Technology key area is as important as culture, contrary to what the literature suggests, which has always highlighted technology relevance in developed countries, which score low of the power distance dimension of the country's culture, which is not a trait of Latin American countries where the multinational's operation is concentrated.*

Keywords: *Knowledge management strategy, knowledge sharing, knowledge-based systems, Maturity model, emerging market multinationals.*

JEL Codes: *M0, M15, O3.*

Paper type: *Research study.*

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1. Introduction

The unstoppable surge of emerging economies is clearly reflected in the sustained growth of foreign direct investment (FDI) flows, which has gone from US 620 billion in 2008 to US 670 billion in 2017, contrasting with FDI in developed countries, which suffered a drastic drop of US421 billion in the last year, going from US 1133 billion in 2016 to US 712 billion in 2017 (UNCTAD, 2006, 2018). This narrowing gap is due, among other things, to the growth and expansion of the multinationals of emerging countries in the global market, which represented 5% on the 'Global 500' rating of the world's biggest companies during the 80S and 90s, raised their participation to 17% in 2010 and are expected to reach 46% in 2025 (McKinsey, 2013).

It has been recently demonstrated in the literature that knowledge management (KM) is a key factor for the multinationals in emerging countries to obtain competitive advantages in the global market since it facilitates creation and transfer of knowledge between the headquarter and its subsidiaries (Claver-Cortés *et al.*, 2018). Specifically, KM enables these firms to emulate innovations coming from technologically developed countries (Li and Kozhikode, 2008; Nair *et al.*, 2016) and even surpass their counterparts of developed countries which have exerted technological and innovative leadership for years (Bruton *et al.*, 2007; Tatiana and Kianto, 2012; Reid, 2018). Nevertheless, KM faces multiple challenges related to the absence of a roadmap orienting the implementation and consolidation of KM practices systemically and gradually, which has led in many cases to the partial removal of this strategy in companies (Pee and Kankanhalli, 2009; Marques *et al.*, 2019).

Therefore, with the aim of overcoming this limitation, since the late XX century several studies have arisen which point towards the articulation of KM with the maturity models coming from software engineering, which combine a maturity scale with key areas, giving rise to guidebooks for the implementation of KM with this methodological approach (Klimko, 2001). The first KM maturity models were developed mainly by consulting firms that achieved quick diffusion among companies at that time, although some conceptual ambiguities and methodological weaknesses were evident. However, in the last decade several studies appeared that resolved a great deal of those seminal works" flaws *(Chen and Fong, 2012; Hsieh et al.*, 2009; Serna M, 2012) and applications in different organizational contexts were also carried out, such as in universities (Wijetunge, 2012), companies (Mochamad and Waluyo, 2015), public entities (Dehkordl *et al.*, 2017) and, in an emerging manner, in multinationals (Robinson, 2012).

In this new stage in which a new generation of KM maturity models has arisen, there has been a consensus around which are the key areas and which is the number of levels of the maturity scale. In detail, the main key areas are: Technology, Knowledge Processes, Culture and Strategy; and the use of a five-level maturity

scale is common: initial, exploratory, used, managed and innovation (Jiankang *et al.*, 2011). Nevertheless, there is a lack of works that describe in a precise manner which are the variables that make up the key areas and which are their respective levels or maturity scenarios. In other words, the maturity levels are usually too generalist and generic because, although they clearly describe in detail the five maturity levels of the key areas, they fail to open the black box and operationalize variables within the key areas.

In addition to that, the studies that seek to verify the reliability and validity of the KM maturity scales are incipient (Hartono *et al.*, 2015; Marques *et al.*, 2019) in their purpose of evidencing its suitability as a method of measuring and diagnosing KM practices in companies. Also, there is a lack of works that exhaustively verify the reliability and validity of the maturity scales of each one of the variables, that is, the reliability and convergent and discriminant validity of the key areas and of the items corresponding to the maturity levels or scenarios of each variable.

On the other hand, since the early XXI century, there has been an interest in the literature to understand the interaction of the technological and cultural components of the traditional KM models with the knowledge processes, with a view to understanding which of the aspects has more relevance for invigorating knowledge flow (Bhatt, 2001). Nevertheless, the results are contradictory; some authors highlight the importance of the human component over the technological one, (Lin, 2007; Lindner and Wald, 2011), while others emphasize the technological aspect (Cerchione and Esposito, 2017; Pérez-López and Alegre, 2012), which is usually dominant and relevant in developed countries scoring low on the power-distance dimension of the country's culture (López-Nicolás and Meroño-Cerdán, 2011; Buenechea-Elberdin *et al.*, 2018).

By contrast, other studies show that both aspects, hard and soft, have a similar impact on the knowledge processes of acquisition, creation, exchange and transfer (Pinho *et al.*, 2012). The KM strategy is usually partially left out from this interaction between technology, culture and knowledge processes, since the literature usually analyses in an almost exclusive way its direct effect on specific knowledge processes such as application, particularly regarding the development of new and improved products and processes (López-Nicolás and Meroño-Cerdán, 2011; Mangiarotti and Mention, 2015).

In relation to KM maturity models, the lack of works exploring the interaction among its components is much more notorious, particularly that of the key areas of technology, culture and strategy with the knowledge processes. In other words, even when the KM maturity models are usually defined as a holistic implementation route offering the possibility to concentrate efforts and resources to obtain competitive advantages in KM (Hsieh *et al.*, 2009; Marques *et al.*, 2019), there are no clear indications in the literature as to which is the key area with the most positive

incidence on the knowledge processes, that is, which of those areas the organization should prioritize to reach their maturity and further invigorate knowledge flow.

According to the above, the aim of this article is to analyze the interaction between the key areas of KM maturity, particularly the effects of Strategy on Culture and Technology, and of these on Knowledge Processes.

2. Knowledge Management Maturity Model

Organizational maturity is achieved when the KM processes are effectively managed and applied (Mochamad and Waluyo, 2015). For assessment, the maturity model presents an approach that describes progress over time from an initial to an advanced level or when a process is defined, managed, measured, controlled and effective (Pillania, 2008; Marques *et al.*, 2019). The maturity stages are grouped into the KM capabilities and practices to be developed, according to the link they have with specific organizational aspects such as technology, culture and processes (Pee and Kankanhalli, 2009; Hsieh *et al.*, 2009) For the case of the food-sector multinational model (Table 1) the capabilities are grouped into four key knowledge areas: Strategy, Culture, Knowledge Processes and Technology (Hsieh *et al.*, 2009; Chen and Fong, 2012), each with variables defined by scenarios representing the maturity scale: Initial, Exploratory, Used, Managed and Innovation (Mohanty and Chand, 2005; Pee and Kankanhalli, 2009). The key knowledge areas and the variables of each area are presented in the next sections:

Table 1. *Key Areas and General Maturity Scale*

Key Areas	**Knowledge processes**	Set of activities enabling the flow of knowledge in the different levels of the business.
	Technology	Alludes to the ICT infrastructure supporting KM.
	Strategy	Refers to the link between the Business strategy and the KM strategy.
	Culture	Includes the organizational factors that influence on the collaborators" willingness towards KM.
Maturity Levels	**Initial**	There are informal KM practices; tacit and individual knowledge prevails; KM initiatives are not aligned with the Business strategy.
	Exploratory	There is an initial definition of KM for the organization and the implications of its implementation are considered; pilot projects are also developed.
	Used	The organization puts in place formal KM practices, which are articulated to the strategy, processes and culture.
	Managed	Advanced and standardized KM practices are implemented; there are follow-up and control through indicators; benefits from knowledge are generated for the Business.
	Innovation	KM practices are continuously improved and optimized; KM flexibly adapts to the new requirements of the Business and leverages innovation.

Source: *Authors.*

2.1 Key Area: Strategy

Strategy is the core of KM, there by its implementation requires precise and efficient understanding of the connection between infrastructure and knowledge process and strategic knowledge focus (Zack, 2002; Choi and Lee, 2002; Utami and Ferdiansah, 2017). Additionally, aspects related to resources and capabilities associated to the deployment of management are considered (Hsieh *et al.*, 2009) three variables are defined:

- KM strategy: the key knowledge areas and their continuity over time for the present and future of the Business are defined (Earl, 2001; Holsapple and Jones, 2011).
- Management's commitment and resources: proactive attitude towards the Business" shared goals for the KM strategy sustainability, which includes allocation of the necessary resources to guarantee the implementation of this strategy over time (Yang *et al.*, 2010; Hsieh *et al.*, 2009).
- KM teams: it refers to forming the team to direct the KM strategy, first to lead its implementation in the businesses and second, as a reorienting team that permanently facilitates and supports the process (Bell DeTienne et al., 2004; Pandey and Dutta, 2013; Bhatt, 2001; Pillania, 2008).

Table 2 presents the articulation of the three variables of the Strategy key area with the five levels of the maturity scale. These scenarios are detailed from the initial to the most developed and consolidated states.

Table 2. *Key Maturity Area: Strategy*

Variables	Initial	Exploratory	Used	Managed	Innovation
KM Strategy (S1)	There are informal KM practices	The Business advances on the formulation of a definition of KM that is articulated with the Business strategy.	There is a link between the Business strategy and KM; the Business key knowledge areas have been identified and practices facilitating it are developed.	The impact of KM on the Business is monitored through indicators and the practices that develop key knowledge for the present and future of the Business are emphasized, following the strategy.	KM has become a key strategic process for all the processes, directly leveraging innovation and the Business strategy.

Management" s commitment and Resources (S2)	There is initial commitment from the managers with the KM process.	Managers" commitment with KM leads to exploring resource allocation (physical, financial, human) for its implementation.	Managers facilitate the necessary resources (physical, financial, human) for the implementation of KM practices.	Managers accompany the evolution of KM in the Business and the indicators that evidence its results.	Managers are fully convinced about KM and its direct impact on the future of the Business, leading to ensuring sustainability of the KM strategy.
KM team (S3)	There is not a person or team who leads KM in the Business.	There is a person who partially accompanies the implementation of KM.	The Business appoints a leader with the responsibility to implement the KM strategy.	There is a consolidated work team who lead the KM strategy in the Business, systematize and transfer the experience in internal and external spaces**.**	The Business collaborators understand their role in KM and perform it with autonomy an commitment, supported by the KM team.

Source: *Authors.*

2.2 Key Area: Knowledge Processes

KM processes are cyclic mechanisms allowing to generate new knowledge, organizational learning and innovations (Lee *et al.,* 2016). In the literature review, authors give different meanings to KM practices. Lee and Choi (2003) define KM processes such as capturing, sharing and using knowledge. Others distinguish those processes into created/acquired knowledge, shared/disseminated knowledge and used knowledge (Soto-Acosta *et al.,* 2016). In this study we adopt the following KM generic activities (Chang and Chuang, 2011; Hsieh *et al.,* 2009; Chen and Fong, 2012):

- Identification and incorporation of market knowledge, which is related to market intelligence and competitive intelligence (Holsapple *et al.,* 2002; Gold *et al.,* 2001; Chen and Fong, 2012).
- Identification and incorporation of knowledge about suppliers (Marra *et al.,* 2012; Gold *et al.,* 2001), in areas related to raw material supply and inventory risks.
- Creation: physical and virtual spaces enabled to facilitate the construction of value proposals for the organization (Von-Krogh, Georg and Nonaka,

Ikujiro; Rechsteiner, 2012; Nonaka and Takeuchi, 1995; Alavi and Leidner, 2001).

- Preservation: knowledge storage and preservation in easy, fast and intuitive repositories are considered (Lee and Lee, 2007; Chang and Chuang, 2011).
- Transfer: It refers to the exchange of tacit and explicit knowledge between collaborators and the different market actors (Alavi and Leidner, 2001; Sabherwal, Rajiv and Sabherwal, 2005; Chen and Tsou, 2012).
- Learning and training: It refers to training topics aligned with the value offer of the Business for the collaborators; it even implies incentives to continue academic studies, participation in fairs, symposiums, business roundtables, and strategies allowing for integral training and the development of collaborators" abilities (Hsieh *et al.*, 2009).
- Application: development of product innovation, process and Business model (Alavi and Leidner, 2001; Sabherwal, Rajiv and Sabherwal, 2005; Hsieh *et al.*, 2009; López-Nicolás and Meroño-Cerdán, 2011) and decision-making based on systematically collected innovation (Courtney, 2001; Desouza, 2006; Tseng, 2010).

Table 3 presents the variables of the Knowledge Processes key area from its initial level to its innovation level.

Table 3. *Key Maturity Area: Knowledge Processes*

Processes	Initial	Exploratory	Used	Managed	Innovation
Identification/incorporation of market knowledge (P1)	In the Business, information on customers-consumers, competitors and technological changes affecting the Business is informally captured.	The Business advances in the identificatio n of key information sources for itself and of mechanisms to capture information on customers-consumers, competitors and technologica l changes affecting it. Pilot projects are carried out	Key sources of external information for the Business and the Group are defined (fairs, investigations, patents, scientific journals, experts, among others); besides, exercises on technological surveillance, competitive intelligence, market studies and sociocultural	Future-scenario building exercises are systematically carried out in relation to consumer behavior, trends, competitors, technologies and new businesses. The information collected serves as feedback for the Business strategy.	New information directly impacting the Business strategy and coming from the analysis pf the environment, new technologies, trends, consumer behavior and the market, is flexibly incorporated.

		in one or several areas or departments.	trends are systematically carried out.		
Identification/incorporation of knowledge about suppliers (P2)	Information about suppliers is informally captured in the Business.	The Business identifies the required suppliers in its operation; besides, it advances in the definition of mechanisms to capture information related to them.	Key suppliers in the operation of the Business are identified; besides, studies on suppliers and risks associated to raw material supply (cost, quality, logistics opportunity, among others) are systematically carried out.	Future-scenario building exercises related to suppliers and risks are systematically carried out. The information collected serves as feedback for the relationship with suppliers.	New information coming from the analysis of suppliers, which directly impacts the Business strategy and gives response to the future scenarios identified, is rapidly and flexibly incorporated.
Creation (P3)	Collaborators create knowledge using personal criteria in an informal way.	The Business advances in the definition of spaces and identification of methodologies for knowledge creation. Pilot tests are carried out in one or several areas.	Knowledge creation methodologies are defined, teams are formed and physical and virtual spaces are enabled for this purpose, oriented to the key knowledge areas for the Business.	Collaborators from all areas and hierarchical levels participate in knowledge creation teams and spaces. Besides, there is follow-up through indicators.	Collaborators create knowledge in networks that link customers, consumers, suppliers, universities and local and international experts. Besides, creation is effectively and flexibly reoriented towards new key knowledge areas.

Preeservation (P4)	Collaborators store the knowledge they consider relevant in personal devices.	Collaborators store key knowledge for the Business in personal devices even though the Business has enabled information systems for its storage.	Collaborators store knowledge from processes and impact projects of the Businesses , including lessons learned, good practices, ideas, proposals and memoirs in information systems (portals, shared folders, among others) enabled by the Business.	There are procedures and standards for storing knowledge and compliance with them is monitored; besides, a way to organize the stored information is structured, and the information systems allow access according to user profile.	The Business key knowledge is stored and organized in the information systems, which collaborators can access easily, rapidly and intuitively; besides, knowledge preservation is part of the organizational culture.
Transfer (P5)	Knowledge is informally shared among collaborators.	The Business advances in the identificatio n of practices for collaborators to share their knowledge.	Formal practices are established for collaborators, especially experts, to share their knowledge. There is transfer and exchange of good practices within each Business.	Practices are established for collaborators to share their knowledge among the Businesses. Internship or mobility and mentory programs are implemented. Transfer and exchange of good practices are developed among Businesses.	Knowledge sharing is part of the organizational culture, which is carried out among the Group"s Businesses and knowledge networks that link external stakeholders (universities, consultants, suppliers, trade organizations, among others)**.**

Learning and training (P6)	There are few talks, visits, trainings, lectures or programs seeking to develop the fundamental knowledge of the Business.	Diagnoses are carried out to establish knowledge gaps between what collaborators know and what they must know; besides, the training, lectures or programs that must be developed in line with the challenges of the Business are defined.	A learning and training program for collaborators is implemented in key areas of the Business, which seeks to close the knowledge gaps and develop the defined competencies.	A program is implemented to foster postgraduate studies, strategic projects, internships or fairs in key knowledge areas for the present and future of the Business.	Collaborators have been able to develop**,** replicate and improve the Business key knowledge.
Application – Innovation (P7)	There is neither a formal strategy to apply knowledge, nor a mechanism to facilitate it**.**	The Business advances in the identificatio n of mechanisms allowing to apply and use knowledge. Pilot projects are carried out in one or several areas.	A mechanism is defined for the development of innovation projects oriented to improve efficiency in the processes, by using the knowledge created or acquired by the collaborators.	The Business develops projects oriented to product innovation and the creation of new business models through the use of the knowledge created or acquired by the collaborators.	The knowledge created or acquired allows the Business to develop new and improved products, processes and business models more effectively than competitors. Besides, the impact of KM on the strategic results of the Business is evident and unquestionable.

Application – Knowledge-based decisions (P8)	Collaborators make decisions about their process based on individual experience.	Collaborators recognize the importance of making decisions related with their process, supported in information from the Business and the knowledge of other collaborators, even though they continue to make decisions based on individual experience.	Collaborators make decisions related to their process, supported in the information stored in the information systems enabled by the Business, which they interpret in an individual manner.	Collaborators make decisions related to their process, supported in the information stored in the information systems enabled by the Business, which they interpret with other collaborators.	Decision-making by collaborators impacts process efficiency, the generation of new business models, the opening of new markets and initiatives that promote the future development of the Business.

Source: *Authors.*

2.3 Key Area: Culture

Corporate culture is related to the beliefs, values and norms appropriated by collaborators, which positively impact the KM strategies (Janz and Prasarnphanich, 2003; Lindner and Wald, 2011; Parashakti, 2018). It implies a favorable attitude towards knowledge exchange, shared learning and collaboration, which leads to the generation of incentives by the organization (Bell DeTienne *et al.,* 2004; Pee and Kankanhalli, 2009). These are the two variables that make up the key area:

- Collaborators' attitude: collaborators' willingness, favorable for the knowledge processes (Lee, H. & Choi, 2003; Bedwell *et al.,* 2012; Bell DeTienne *et al.,* 2004).
- Incentive systems: recognition scheme of the knowledge processes that leverage the business strategy and motivate collaborators (Yang *et al.,* 2010; Pee and Kankanhalli, 2009).

Table 4 describes the variables of the Culture key area with the scenarios according to the maturity level - initial, exploratory, used, managed and innovation.

Table 4. *Key Maturity Area: Culture*

Variables	Initial	Exploratory	Used	Managed	Innovation
Collaborators' attitude (C1)	Collaborators sporadically share some learning and experiences.	Collaborators take conscience of the importance of sharing their learning and experiences, and do so occasionally.	Collaborators share their learning and experiences with closer work teams of their preference.	Collaborators periodically promote spaces for sharing experiences, learning and ideas within Nutresa group, with external experts that complement them and contribute new visions.	Collaborators have the habit of, and enjoy, managing knowledge within the Business and the Group, and with external experts. They do this with humbleness and initiative.
Incentive systems (C2)	The Business does not have mechanisms to value and recognize KM.	The Business explores mechanisms to value and recognize KM.	There are mechanisms to value and recognize KM.	The implementation of mechanisms of value and recognition invigorates KM and leverages meeting the Business goals.	The mechanisms of value and recognition are permanently improved and reach all levels of the Business, leveraging innovation.

Source: *Authors.*

2.4 Key area: Technology

Information and communications technologies (ICT) play a fundamental role in improving KM (Intezari *et al.*, 2017; Marra *et al.*, 2012; Riyanto *et al.*, 2018).They are mechanisms that operate as facilitators to generate interactions with collaborators, who are the main KM users (Kebede, 2010; Choi *et al.*, 2010). For this study, technological infrastructure, hardware, software and other tools (Maier and Hadrich, 2006) that improve KM processes (Al-Aama, 2014) are considered, as well as more cognitive and attitudinal aspects (Oliveira and Martins, 2011; Elias, Steven; Smith, William and Barney, 2012), which enable appropriation of the technologies by collaborators. Thus, this key area is made up of the following variables:

- ICT for KM: ICT infrastructure that supports collaborative work, learning, identification of experts and knowledge integration (Pérez and Dressler, 2007; Maier and Hadrich, 2006).

- ICT appropriation: related to the routine ICT knowledge of collaborators to find solutions and quickly adopt them in their daily tasks (Durcikova *et al.*, 2011; Kuo and Lee, 2011; Oliveira and Martins, 2011).

Table 5 exhibits the maturity levels for each one of the variables of the Technology key area.

Table 5. *Key Maturity Area: Technology*

Variables	Initial	Exploratory	Used	Managed	Innovation
ICT for KM (T1)	The Business only has Word, Excel, Power Point and electronic mail tools to support KM.	The Business identifies and plans the implementation of Information and Communications Technologies (ICT) that support KM.	Information and Communications Technologies are enabled for KM, specifically to support collaborative work and the identification of experts in each Business. (portals, applications, social networks, among others)	There is a technology platform transversal to all the Businesses, which integrate knowledge generated in the Group.	There is a technology platform of Nutresa group that facilitates KM and innovation, promoting collaborative work with internal and external entities.
ICT appropriation (T2)	Collaborators know about the existence of Information and Communications Technologies that support KM in the Business.	Collaborators know the importance and scope of the use of the Information and Communications Technologies that support KM in the Business.	Collaborators often use the Information and Communications Technologies that support KM, finding benefits in their work.	Permanent use of Information and Communications Technologies favors a platform of shared knowledge in the Business, which invigorates collective learning.	Collaborators use Information and Communications Technologies for KM daily and autonomously. Besides, they find new ways to use and rapidly adopt the new ICT implemented in the Group.

Source: *Authors.*

3. Influence of the Strategy Key Area on Culture and Technology

The statement of key knowledge, implicit in the formulation of the KM strategy, plus the management's commitment and the existence of a KM team, generate immediate changes in the layers of organizational culture (López-Nicolás and Meroño-Cerdán, 2011; Parashakti, 2018), both in the most visible, called artifacts and norms including language, ritual, among other aspects, and in the least visible, called values (Hogan and Coote, 2014). In particular, the KM strategy supposes changes in organizational discourse; for instance, managers start using words such as innovation or collaborative work systematically in their talks rather that emphasizing quality or customer service, with the purpose of generating changes in the system of values and beliefs. Thus, the main impact of the KM strategy on the Culture key area consists in triggering a change in favor of the value of collaboration in its least visible layer, which is undoubtedly the most important soft factor for KM (Intezari *et al.,* 2017), and in the most visible layer, the implementation of an incentive system that helps routinize collaboration among employees.

Likewise, KM strategy also has incidence on the Technology key area, because once the key knowledge is made explicit, actions towards alignment, updating and even redesign of the existing information technology system are generated, with the aim of supporting information gap filling (López-Nicolás and Meroño-Cerdán, 2011; Cerchione and Esposito, 2017). Added to this, the deployment of the KM strategy, which implies the management's support and actions developed by the KM team, translates into greater demand of IT use for employees, training for this purpose, and even control and follow-up of use indicators (Xiaojun, 2017; Oliveira and Martins, 2011). In the long run, this generates IT appropriation by employees in terms of habitual use and the ability to adopt the new IT of the multinational. Therefore, the following hypotheses are posited:

H1. *The Strategy key area positively influences the Culture key area.*

H2. *The Strategy key area positively influences the Technology key area.*

4. Influence of Culture Key Area on Knowledge Processes and Technology Key Areas

Organizational culture is the main mechanism of knowledge creation and exchange in the organization *(Gupta and Govindarajan, 2000; Marques et al.,* 2019; Parashakti, 2018) and depends on its collaborators' behavior, since they are the ones who give meaning to new data and information, share solution alternatives and restructure shared meanings allowing to identify the why and the how of knowledge generation, transfer and application (Pee and Kankanhalli, 2009; Parashakti, 2018). In this way, culture influences on the organizational memory for the appropriation of the cyclic model of knowledge, which starts with identification and ends with

knowledge application. Zheng, Yang and McLean (2010) mention that Culture has a greater contribution to knowledge than other key knowledge areas since knowledge practices are associated to the cultural values which translate into value for the organization.

This premise allows the maturity of collaborators' attitude towards KM and the organization's recognition schemes to be related with the maturity of KM practices. Additionally, informal mechanisms in KM such as culture are applied simultaneously to support the knowledge processes (Nielsen and Michailova, 2007).

Furthermore, the cultural aspect is related with technology, since the latter functions as a KM facilitating mechanism (Davis *et al.,* 2005) and for collaborators to generate appropriation and use of technology, it is fundamental to take into account social and cultural aspects (Intezari *et al.,* 2017). Based on the above, the following hypotheses are proposed:

H3. *The Culture key area positively influences the Knowledge Processes key area.*

H4. *The Culture key area positively influences the Technology key area.*

5. Influence of Technology Key Area on Knowledge Processes Key Area

Technology is one of the factors directly affecting knowledge processes and it is important to relate them to create positive contexts in KM (Pinho *et al.,* 2012; Riyanto *et al.,* 2018). This key knowledge area allows ICT to support knowledge identification, preservation, transfer and application, so it facilitates interaction and knowledge flow for any organization (Coakes *et al.,* 2010). In addition to this, technological infrastructure is important for the integration of knowledge in the management decisions and practices that generate appropriation and impact learning processes and collaborative work to go from individual to collective knowledge (Intezari *et al.,* 2017). Therefore, the following hypothesis is posited:

H5. *The Technology key area positively influences the Knowledge Processes key area.*

6. Methodology

6.1 Measurement and Sample Procedure

The development of the measurement scales derives from a combination of qualitative and quantitative instruments. The literature review allowed to propose constructs and measurement indicators, which were refined in meetings with the researchers and the KM primary groups of a food multinational company with 14 strategic business units belonging to 5 business lines: meat, cookies, coffee,

chocolates and pasta. Each one of the items was rated on a scale from 1 to 5, representing five maturity levels: Initial, Exploratory, Use, Managed, Innovation. Table 6 presents the main characteristics of the sample.

Figure 1. *Research model*

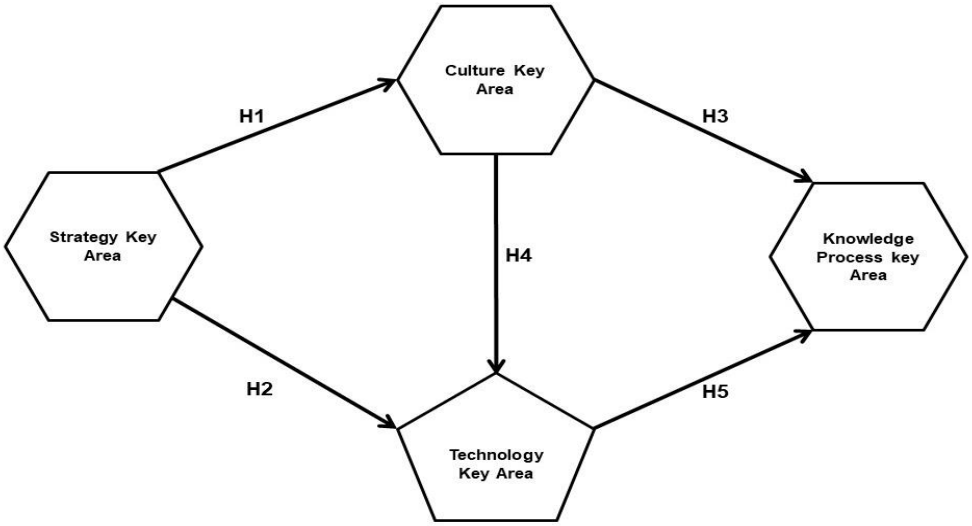

Table 6. *Characteristics of the sample*

Variable		**%**
Strategic Business Unit	Colcafé (Coffee roasting)	9%
	Doria (Pasta and noodles)	6%
	Comarrico (Pasta and noodles)	3%
	Noel (Biscuits)	10%
	Litoempaques (Food packaging)	4%
	Pozuelo (Biscuits)	9%
	Molino (Biscuits)	3%
	Zenú (Cold cuts)	12%
	Chocolates	10%
	Shared service center	7%
	Novaventa (Vending machine)	8%
	Ice cream	10%
	Comercial nutresa (Commercialization)	6%
	La Recetta	4%
Age	Between 18 and 25 years old	7.53%
	Between 26 and 35 years old	41.40%
	Between 36 and 45 years old	30.58%
	Over 45 years old	20.49%
Time of permanence	Less than 2 years	11.40%
	Between 2 and 10 years	56.20%
	Over 10 years	32.30%

Position level	Top-level management	5%
	Middle-level management	23%
	Low-level management	27%
	Operational	45%

Source: *Authors***.**

Subsamples were calculated for each strategic business unit applying stratified sampling with proportional allocation, using the hierarchical levels of each organization as strata: operational, low-level management, middle-level management and top-level management. For the whole multinational, a sample of 2,932 collaborators was obtained, for a confidence level of 95% and an error of 1.81%, assuming a finite population given its size (N=45,618 employees in all the countries). For the sample frame, individuals with a time of permanence lower than six months in the multinational were not included, since for identifying the KM maturity level, some level of experience in the organization was considered important, in order to obtain a measurement better adjusted to the study object.

The field work was conducted between June and November of 2015, using virtual and physical surveys for the operational, low-level management, and middle-level management levels, and structured personal interviews for the top-level management.

6.2 Data Analysis

We developed a structural equation modeling (SEM) analysis by the partial least squares (PLS) method (Hair *et al.*, 2019). Reliability and convergent validity were verified in the model, as evidenced in Table 7. All the factor loadings were significant and above 0.6; the Cronbach's Alpha (CA), Composite Reliability (CR) and Average Variance Extracted (AVE) indicators were adequate (above 0.7, 0.7 and 0.5 respectively) in all cases as indicated in Table 7.

Table 7. *Reliability and Convergent Validity*

Construct	Item	Original Factor Loading	Sample Mean	Standard Deviation	T Statistic	P Values	CA	CR	AVE
Strategy	S1	0.795	0.795	0.010	81.190	0.000	0.772	0.844	0.644
	S2	0.866	0.866	0.006	149.568	0.000			
	S3	0.743	0.742	0.011	65.144	0.000			
Culture	C1	0.891	0.891	0.004	198.908	0.000	0.746	0.887	0.797
	C2	0.895	0.895	0.004	214.218	0.000			
Processes	P1	0.701	0.702	0.011	63.498	0.000	0.893	0.916	0.609
	P2	0.809	0.809	0.008	103.197	0.000			
	P3	0.784	0.783	0.008	93.026	0.000			
	P4	0.755	0.755	0.009	83.118	0.000			
	P5	0.802	0.802	0.008	95.896	0.000			
	P6	0.807	0.807	0.008	102.550	0.000			
	P7	0.800	0.800	0.008	100.744	0.000			

Technology	T1	0.904	0.904	0.004	217.550	0.000	0.785	0.903	0.823
	T2	0.910	0.910	0.004	250.912	0.000			

Source: *Authors*.

Discriminant validity was verified following the Fornell-Larcker procedure (Fornell and Larcker, 1981), evidencing that the square root of the AVE of each construct was greater than each correlation with the rest of the constructs, as indicated in Table 8.

Table 8. *Discriminant validity*

	Strategy	**Culture**	**Processes**	**Technology**
Strategy	**0.803**			
Culture	0.696	**0.893**		
Processes	0.711	0.779	**0.781**	
Technology	0.575	0.637	0.764	**0.907**

Main diagonal: Square root of the AVE; **Below the main diagonal:** Correlations between constructs

Source: *Authors.*

Having guaranteed the reliability and validity of the model, the hypotheses contrast is presented. All the hypotheses obtained relevant and significant loadings, as evidenced in Table 9.

Table 9. *Hypotheses testing*

Hypotheses	**Original Sample**	**Sample Mean**	**Standard Deviation**	**T Statistics**	**P Values**
Culture -> Processes (R^2=0.72; Q^2=0.41)	0.492	0.492	0.015	33.787	0.000
Culture -> Technology (R^2=0.44; Q^2=0.34)	0.459	0.460	0.022	21.093	0.000
Strategy -> Culture (R^2=0.48; Q^2=0.37)	0.696	0.695	0.012	59.599	0.000
Strategy -> Technology	0.256	0.256	0.022	11.449	0.000
Technology -> Processes	0.450	0.450	0.015	29.859	0.000

Source: *Authors.*

Predictive validity was also verified, represented in Table 9, through the Q2 indicator of the dependent constructs, which was obtained by means of the blindfolding technique, yielding Q2 above 0 for all cases. Additionally, R2 indicators also obtained adequate values, and it is noticeable that a high proportion of the maturity variance of the KM processes (72.6%) is explained through the model.

7. Discussion and Conclusions

Regarding the interaction between the key areas of the KM maturity model, the results evidence the central role of strategy and culture. In particular, it is observed

that the effect of strategy on culture is the highest (β = 0.70) as compared to the rest of the relationships between key areas. This shows the importance of establishing the key knowledge gaps, of ensuring the management's commitment with KM and of having a team to coordinate the deployment of KM practices to achieve a culture oriented to collaboration and IT appropriation, given the incidence of the Culture key area on technology (β = 0.46). Also, it is evidenced that strategy has a significant effect on the Technology key area (β = 0,26) but lower as compared to culture, probably because in emerging countries and in companies belonging to low-technology sectors such as the food sector there is usually greater orientation toward the personalization strategy than to codification (López-Nicolás and Meroño-Cerdán, 2011; Buenechea-Elberdin *et al.*, 2018). In contrast, the direct effect of the Technology key area on knowledge processes (β = 0,45) is practically similar to that of Culture (β = 0,49). Therefore, all the hypotheses are accepted.

In sum, there are several academic contributions in this paper. Firstly, the work is pioneering in evidencing the interaction between the different key areas of a KM maturity model, departing from the assumption that the KM strategy is the organizational factor that aligns culture and technology so that they support knowledge processes. This contribution is significant since the empirical works in the literature insist on analyzing in a specific and isolated manner the direct effects of the KM strategy on some specific knowledge processes. However, in this article it is evidenced that the KM strategy is crucial in the functioning of the maturity model, and that its effects on the knowledge processes are rather indirect through culture and technology.

Another interesting finding shows that the influence of technology on knowledge processes is similar to that of culture. Hence, the work contributes to elucidating the still open controversy around which of the two key areas, hard or soft, becomes more important when it comes to invigorating knowledge flows. In this sense, the results agree with one of the three identifiable stances in the literature that shows itself in favor of equally recognizing the importance of both. However, it is worth noticing the parity of the impacts of technology and culture, since previous studies suggest that this hard key area is relevant, especially in developed countries, which score low on the power distance dimension in the country's culture (Merono-Cerdan *et al.*, 2007; Braga *et al.*, 2018; Buenechea-Elberdin *et al.*, 2018).

This is contrary to what happens in emerging countries, where the operation of the multinational is concentrated. Behind this result, however, can be the fact that multinationals are forced to mature the IT key area due to the geographical dispersions of their operation, that is to say, to intensively deploy an IT system for KM and prioritize IT appropriation by collaborators. This finding is quite significant given that studies on KM maturity in multinationals are mainly theoretical (Robinson, 2012).

The work also breaks the tradition of proposing generic and generalist maturity models, since it proposes an innovative KM maturity model by offering a description of the five maturity levels of each one of the variables that make up the key areas, that is to say, it offers a greater degree of specificity and operativization. Furthermore, these maturity scales proposed present satisfactory reliability and validity indicators. In this way, it was possible to overcome a historic limitation of the KM maturity models since, on the one hand, the work succeeds in opening the black box of key areas and, on the other, propose some KM maturity measurement scales, which will allow to widen the research horizon, explore the relationship with other organizational factors and moderate the surge of case studies or implementation reports that have prevailed in the past years.

Hence, the contributions to managerial practice are evident; the KM maturity model proposed is a very complete and reliable KM diagnostic tool, both for subsidiaries about to deploy KM strategies as well as for those that have certain experience in the area, which helps fix a clear baseline to start improvement actions conductive to the highest maturity level. Likewise, this model is a true road map to guide KM implementation in the multinational in more detail, which will allow to develop a common language and carry out comparative work to identify and transfer best practices from the headquarter to the subsidiaries and vice versa. Additionally, this tool becomes a balanced scorecard of KM, allowing to monitor and exert greater control of advances in terms of the maturity of the key areas in each one of the subsidiaries.

Regarding the study limitation, it must be pointed out that the results are limited to multinationals operating in emerging countries, particularly in countries where the country's culture has a relatively high score on the power distance dimension which conditions the KM strategy, due to the preference for personalization strategies, and therefore, for the use of technology (Merono-Cerdan *et al.*, 2007; Buenechea-Elberdin *et al.*, 2018).Thus, there would be limitations to generalize the results of this study to companies located in other contexts, such as developed countries, where the country's culture conditions KM otherwise, and which have a privileged position in terms of IT adoption in businesses, particularly related to infrastructure and accessibility (WEF, 2016)

Hence, future studies should analyze the interaction of the KM maturity model key areas in other types of contexts, particularly in multinationals operating in developed countries. In a different vein, KM maturity should be connected to two literature currents. Firstly, in the internationalization field there is a series of recent studies approaching the dual embeddedness of the multinational, that is to say, how it manages to timely respond to changes in multiple local contexts in which it operates through the acquisition of strategic assets from internal and external networks (Figueiredo, 2011). Therefore, the role of KM maturity as antecedent of embeddedness should be analyzed, particularly that of external embeddedness,

where it could be a key tool to invigorate the flow of knowledge between the subsidiary and the allies of a particular local context.

Secondly, in the field of KM, there is a current that has been analyzing the negative incidence of certain soft aspects related to organizational culture on knowledge flow, the "not-invented-here" or "not-shared-here" syndromes (Arias *et al.*, 2017), or the impact of key knowledge drain (Frishammar *et al.*, 2015), among others. Therefore, it would be of great usefulness to analyze the moderating effects of these phenomena on the interaction between key areas of the KG maturity model. For instance, how key knowledge drain negatively moderates the relationship between the Culture-Technology key areas and knowledge processes, particularly in the context of multinationals whose subsidiaries operate in emerging countries where intellectual property appropriation or protection regimes are weak (Hurmelinna-Laukkanen and Puumalainen, 2013), and where the geographical dispersion of the operation and the prevalence of personalization further increase the risks of key knowledge expropriation.

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