

LINKING KNOWLEDGE MANAGEMENT MATURITY AND INNOVATION IN LEADING COMPANIES IN RESEARCH AND DEVELOPMENT *

Conectando madurez en la administración del conocimiento con innovación en empresas líderes en investigación y desarrollo

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ABSTRACT

The relation between knowledge management (KM) and innovative performance has always been mentioned in scientific literature; however, it has become a black box because there are few studies showing detailed characterization. The aim of this paper is to explore the existing relation between knowledge management maturity (KMM) and product and marketing innovation in leading R&D companies. A survey was applied to R&D staff and then, Chi Square test was used to establish associations among variables. As a result, the collection of knowledge is the variable that has the most significant impact on both types of innovation. It is also important to mention that Meaning Management is related to product innovation, as KM technologies to marketing innovation. In conclusion, it is evident the importance of KM variables related to cultural aspects on product innovation, while those related to technological aspects have more impact on marketing innovation.

Fecha de recepción: 1 de abril de 2015. Fecha de aceptación: 12 de mayo de 2015.

- * El presente artículo de investigación se deriva del proyecto de investigación «Evaluación del impacto de las actividades de innovación sobre el desempeño financiero en empresas antioqueñas líderes en I+D+i», financiado por el CODI en el periodo 2013-2014.
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Keywords: Knowledge Management; Maturity Model; Innovative Performance; Product Innovation; Marketing Innovation.

RESUMEN

La relación entre gestión del conocimiento (GC) y el desempeño innovador se ha mencionado de forma reiterativa en la literatura científica; sin embargo, se ha convertido en una caja negra porque son pocos los estudios que han caracterizado con detalle los vínculos entre los dos constructos. El propósito del artículo es explorar la relación existente entre la madurez de la gestión del conocimiento (MGC) y las innovaciones de producto y marketing en empresa líderes en I+D. En cuanto a lo metodológico, se aplicó un cuestionario a los integrantes de los equipos de I+D, posteriormente se realizó la prueba Chi cuadrado para establecer asociaciones entre las variables. En cuanto a los resultados, se evidencia que la recopilación de conocimiento es la variable que presenta la asociación más significativa con ambos tipos de innovación. También, es importante resaltar que la gestión de significados está relacionada con la innovación de producto, mientras que las tecnologías de GC lo están con la innovación de marketing. En conclusión, es notoria la importancia de las variables de GC de corte cultural con la innovación de producto, mientras que los aspectos tecnológicos tienen un mayor impacto sobre la innovación de marketing.

Palabras clave: Gestión del conocimiento, modelos de madurez, desempeño innovador, innovación de producto, innovación de marketing.

INTRODUCTION

Knowledge management has become the key factor that determines organizations' capability to face the changing needs of customers, the pressure from competitors and the constant technological change (Bueno, 1998; Drucker, 1993; Safón, 2000; Scarbrough, 2003; Nonaka and Takeuchi, 1995).

During the eighties, technological breakthroughs rose, they improved the existing data collecting processes and their transfer towards the heart of organizations. Later on, during the mid nineties, the well-known socialization-externalization-combination-internalization (SECI) model appeared (Nonaka and Takeuchi, 1995). This model is oriented towards knowledge creation from interaction between people supported by Information Technologies. Since then, two important knowledge management perspectives have been consolidating: the functionalist and the interpretative (Schultze, 1998; Salmador, 2006; Moteleb and Woodman, 2007; Arias and Aristizábal, 2011).

The first one considers knowledge exists as a representative object of reality; it is likely to be gathered, coded, manipulated and stored. The second one conceives it as a symbolic construction which emerges from the interaction of individuals at intersubjectivity, and consequently, it is determined by the language and the context particularities (Nonaka and Konno, 1998).

However, companies have had difficulties in order to implement this type of practices in a gradual and systematic way. This is due to the lack of guidelines describing a precise and clear path (Pee and Kankanhalli, 2009). This fact has helped articulating knowledge management with maturity models coming from software engineering (Gallagher and Hazlett, 1999) in order to create measurement scales; these show the transition through a series of stages starting from a chaotic one to an optimized one where individuals use, improve and exploit this intangible asset in an effective and autonomous way (Sinha and Date, 2014; Lotti, 2014).

Now, knowledge management maturity is not a goal itself; literature relates it to innovative performance (Nonaka and Takeuchi, 1995). This has powered a series of studies oriented to analyze this link; it seeks for dynamizing products, processes, managerial practices and ways of commercialization.

Nevertheless, in Colombia, very few studies on this topic have been conducted, maybe because innovation is understood mainly as a phenomenon exclusively related to technology and R&D (Vargas and Castellanos, 2005; Robledo and Ceballos, 2008) where interaction and knowledge creation derived from the interaction among the members of an organization has been underestimated or even ignored.

The companies (object of this study) are also interested in improving their knowledge management strategies focusing on the ones with a high incidence on product innovation and marketing strategies; both have become a priority over process and managerial innovation. This is why this article is important; it explores the relation between knowledge management maturity and the results in product innovation and marketing strategies. In order to present these, the paper develops a maturity model inspired in Durango y Arias' proposal (2011). This one integrates the Functionalist and Interpretative perspectives and covers four key areas: People and Organizations, Processes, Technology and Interpretation.

The article will firstly introduce the knowledge management maturity model; then product innovation and marketing strategies. After, it will show the relation between knowledge management and innovation; it will describe the

methodology used, it will analyze the results and finally, it will present the conclusions drawn

1. KNOWLEDGE MANAGEMENT MATURITY

Maturity models are guidelines which establish principles or a set of practices for the development of an entity through time; in the entrepreneurial context, this entity is usually a process or new technology (Klimko, 2001).

The models include two main components. The first one is a maturity scale which is composed by 5 levels describing the development of an organizational process (in this case, knowledge management processes). The second component includes the important areas related to the practices in the distinct levels (Gallagher and Hazlett, 1999).

Concerning the emergence of knowledge management maturity models, it has been observed that they are mainly Functionalist oriented towards the implementation of knowledge processes, information technologies and the intervention of the different supporting organizational variables (Pee and Kankanhalli, 2009; Jung et al, 2009). However, Desouza (2006) states that the Functionalist perspective emphasizes the organizational aspects in opposition to the cognitive dimension; this is why the authors propose a maturity model close to the interpretative approach which basically seeks for promoting meaning management and actions based on semiotics and learning theories.

Despite of the fact that researchers have successfully achieved blending the main functionalist maturity models (Pee and Kankanhalli, 2009; Lotti, 2014), integrating the elements belonging to the knowledge management's interpretative perspective is now at an initial stage. At this stage, it is remarkable the lack of research on this field other different than Durango y Arias' (2011). Their work includes a maturity scale and four key areas: People and Organizations, Processes, Technology and Interpretation. The first three ones are close to the functionalist approach and the last one, to the interpretative.

2. MATURITY SCALE

The maturity scale is composed by the levels indicating the degree of development and consolidation of the various key areas, usually in terms of practices, an organization should go through in order to achieve the optimum knowledge management level (Pee and Kankanhalli, 2009; Sinha and Date, 2014; Lotti, 2014).

Most of maturity models include 5 maturity levels (Durango y Arias, 2011; Pee y Kankanhalli, 2009; Jung et al, 2009); however, authors like Essmann and Du Preez (2009) recommend reducing them to three levels in order to make the structuring of the measuring instrument and data processing easier; these three levels are:

- Ad hoc and Limited. At this point, knowledge management is in a state featuring improvisation and informality.
- Formalized and Predictable. This level shows how practical improvements to the variables in the key areas have been applied.
- Integration, Synergy and Autonomy. At this level, knowledge management is institutionalized so that the people conduct the practices in an autonomous way; they are constantly enhanced and are articulated to the organization's business processes.

3. KEY AREAS AND ARTICULATION WITH THE MATURITY SCALE

Concerning the key areas, Durango y Arias' knowledge management maturity model (2011) besides showing progress at integrating the Functionalist and Interpretative perspectives, has proved to have an additional strength: it clearly identifies the variables of the four key areas; the first one, People and Organizations Area, include:

- Trust. This talks about the individuals' faith in their managers and coworkers' skills and intentions. This trust increases by implementing practices encouraging empowerment, informal relationships and physical proximity (Lee and Choi, 2003; DeTienne et al, 2004; Nonaka and Takeuchi, 1995; Nonaka and Konno, 1998; Arias and Aristizábal, 2008; Quinn et al, 1996; Arias and Durango, 2009).
- The T-Shaped Skill. This refers to the individuals' expertise at work, their knowledge on how this work articulates with the one done by their coworkers; it is achieved by training in the specific areas of knowledge, by encouraging interdisciplinary and interfunctional teamwork and job rotation (Lee and Choi, 2003; Nonaka and Takeuchi, 1995; Rastogi, 2000).
- Incentive System. This means the set of mechanisms which seeks for symbolically and economically compensating knowledge creation and exchange (Pee and Kankanhalli, 2009; Frid, 2003; Davenport and Prusak, 1998).

- Knowledge Management Strategy. It refers to formulating course of action for knowledge creation and exchange oriented to people or technologies (Ewing and West, 2000; Tiwana, 2002; Zack, 1999).

Concerning the Processes Area, it is composed by:

- Creation. Understood as the development of new knowledge regarding specific areas; the organizations have to provide adequate mechanisms like innovation tools, practice communities and virtual networks (Zhao, 2010; Nonaka and Takeuchi, 1995; Nonaka et al, 2001; Wang and Ahmed, 2003; Gold et al, 2001; Chen and Huang, 2007; Frid, 2003).
- Compilation. It refers to the gathering and storing of information; it implies defining the external sources of relevant data, the storing protocol and enable institutional knowledge repositories (Zack, 1999; Arias y Durango, 2009; Rastogi, 2000).
- Dissemination. It deals with the conditions to access the information and its diffusion; this implies defining the criteria to grant permission, to block, restrict and send information according to each individual's needs (Holsapple and Joshi, 2002; Tiwana, 2002; Arias y Durango, 2009).
- Application. This one is related to learning and how to use knowledge in daily tasks and the generation of innovation; it basically implies implementing Learning by Doing Strategies and developing concrete innovation projects (Zhao, 2010; Frid, 2003; Von et al, 2000; Alavi and Leidner, 1999; Essmann and Du Preez, 2009).

The Technology area involves:

- Knowledge Management Technologies. It is about the set of tools helping improving the efficiency of people at their working posts, finding expert people, documenting, storing and diffusing internal knowledge; it also supports interaction, external information gathering, dynamizing learning processes and problem solving. Among others, we can mention the yellow pages, the learned lessons, the groupware, data mining and the expert systems (Gottschalk, 2006; Tiwana, 2002; Pérez and Dressler, 2007; Arias and Durango, 2009).
- The Knowledge Management Technologies Administration. This refers to the design and implementation of knowledge management technology systems articulated with the organization's business processes; this one is constantly improved (Pee and Kankanhalli, 2009 ; Nonaka and Konno, 1998).
- Attitude towards the knowledge management technologies is the position individuals take facing the use of these technologies; it is related with their

skepticism or readiness for adopting them, or even proactivity (Morales et al, 1999; Pérez and Dressler, 2007).

Concerning the Interpretation Area, it can be said that it is composed by Meaning Management and Action Management. The first one is related to the ability of people to give a sense to information, based on quantitative methods defined by the organization. It, at the same time, introduces new values and beliefs supporting this process. The second one refers to the ability to react consequently to the meanings previously perceived, to provide feedback and to take proper action (Desouza, 2006; Arias and Aristizábal, 2011).

One of the most important aspects of this paper is the issue of articulating the four key areas with the three levels in the maturity scale (see appendixes A, B, C and D). In this way, the paper looks for overcoming the methodological restrictions in Durango y Arias' maturity model (2011) which proposes 5 levels of maturity.

4. KNOWLEDGE MANAGEMENT AND INNOVATION

Knowledge management is not an objective itself, it is in deed, a means towards innovation generation (Nonaka and Takeuchi, 1995). This generation mainly depends on knowledge which must be identified and exploited so the development of new and improved products and processes is constant and effective (Adams and Lamont, 2003; Cardinal et al, 2001; Darroch and McNaughton, 2002; Pyka, 2002; Du Plessis, 2007).

Consequently, it is common to find literature referring to knowledge when defining innovation; it is understood as a new knowledge creation process which seeks for developing viable and commercial solutions (Herkema, 2003), and generates products, systems or processes (Gloet and Terziovski, 2004).

Likewise, when reading about knowledge management, references to innovation are always present. This one is defined as the formal process of access to expertise for the members of an organization. This leads to the creation of new skills, improves performance, dynamizes innovation and generates added value for the customers (Gloet and Terziovski, 2004).

This is why several authors have started to identify the impacts of knowledge management on innovation processes. One of these impacts is on the consolidation of cooperative work which helps members of the organizations to acquire knowledge, generate new ideas and develop their skills (Pyka, 2002;

Cavusgil et al, 2003). In addition to this, we can mention that it has caused a positive impact on data management leading to increase efficiency and effectiveness of the activities related to the creation of new and improved products and processes (Shani et al, 2003).

In the same way, knowledge management assists the integration of knowledge created from internal and external sources and its transformation into a component of the innovation process (Chen et al, 2004); this implies gathering it, categorizing it, storing it and distributing it to all individuals in order to promote thinking, dialogue, learning and the development of new products and services (Du Plessis, 2007).

In this sense, Du Plessis (2007) states that knowledge management plays 5 roles in innovation:

- Access and codification of people's tacit knowledge through identifying the experts, elaborating knowledge maps and yellow pages; this helps reducing risk and cost inherent to innovation processes.
- Explicit knowledge management placed in data bases and other physical or virtual repositories. This helps members of the organization easily access it and combine it in diverse ways promoting innovation.
- Encouraging cooperative work and the creation of networks, particularly informal ones which positively affect innovation (Pyka, 2002) since they endorse the emergence of some intangible assets like trust, commitment, wardship, and cooperation; it dynamizes tacit and explicit knowledge flow within the organization (Von et al, 2000).
- Establishment of creation, exchange, gathering, and application of knowledge into the innovation process.
- Encouraging a favorable organizational culture for innovation thanks to the activities of knowledge measuring and promoting, and compensations given for creating and exchanging knowledge (Gloet and Terziowski, 2004).

The fact is that in literature two perspectives can be identified when exploring the relation between knowledge management and innovation. One of them is centered on knowledge processes and the other one on organizational variables or supporting processes; the first one establishes as independent variables the acquisition, application and the conversion (Ju, Li, Lee, 2006); the acquisition and the generation (Díaz et al, 2008), the exploration and exploitation (Donate and Guadamillas, 2008), or the acquisition, dissemination and capacity

of response to the knowledge demands from the environment (Darroch and Mcnaughton, 2002; Allameh and Abbas, 2010).

The second perspective, on the other hand, presents as basis the emotional commitment, the human resources practices, the informal communication, project teams, information technologies and communications (Pyka, 2002; Cavusgil et al, 2003; Du Plessis, 2007). Now, the previously mentioned knowledge management maturity model integrates both perspectives. The first one deals with the key area of Processes. The second one integrates the other three (people and organizations, Technology and interpretation).

In Colombia, the situation is totally different. The relation between knowledge management and innovation practically remains unexplored. Instead, there is a strong interest for diagnose and evaluate innovation in the industrial sector (Malaver and Vargas, 2004), in the telecommunications sector (Herrera, 2008), in the regional clusters (Becerra and Naranjo, 2008), in the biotechnological sector (Gorbaneff, et al, 2006), in the small and medium-sized enterprises (Torres, Castellanos and Fúquene, 2007), in the University - Enterprise - State relation (Cortés, 2006); and in relation to the technological management, through technological observation (Vargas and Castellanos, 2005) and simulation and system dynamics (Robledo and Ceballos, 2008).

Nevertheless, the little empirical evidence indicates that knowledge originated from managers and employees (internal), and from customers (external) constitutes the main input for innovation in Colombian industry. It also reveals that those actors are the most common source of innovative ideas; it shows a close relation between them (Malaver and Vargas, 2004).

5. PRODUCT INNOVATION AND MARKETING STRATEGIES

Exploring the relation between knowledge management and innovation we found that most of the literature focuses on concrete outcome or results regarding the creation or improvement of products and processes (Donate and Guadamillas, 2008; Ju, Li, Lee, 2006; Díaz et al, 2008; Darroch and Mcnaughton, 2002; Allameh and Abbas, 2010).

However, this article only refers to product innovation and marketing strategies. The first one is seen in terms of launching goods and services, new or improved oriented to the local and international markets. The second one is related to the implementation of new or improved commercialization ways based on the introduction of changes in packaging, price, distribution channel and promotion

influencing brand image (Malaver and Vargas, 2004; Torres et al, 2007; Arceo, 2009; OCDE, 2005).

Nonetheless, in this particular context, this notion of new products for an international market is excluded. The research only covers the perceived image for local consumers; additionally, marketing innovation is limited to the improvements in packaging and brand image of the companies object to this study. Based on the foregoing, the following hypothesis is proposed:

H1. Maturity of knowledge management has a positive association with product and marketing innovation in leading R&D companies.

6. METHODOLOGY

This is a cross cutting quantitative research (Hernández et al, 2006) since data were collected only once. This helped establishing the variable values of the four key areas in the knowledge management maturity model, product innovation and marketing strategies in order to determine the associations among them.

The companies object of this research are situated in Medellin, Colombia and are known for being leaders in R&D, knowledge management and their results in innovation. Besides, these big companies are also known for having a close link to local universities, leaders in research; both, universities and companies have developed several projects together. The interviewed people belong to the R&D Departments. These persons have a wide vision of the key areas in the maturity model.

In detail, this exploratory research was conducted in a liquor company whose income exceeded US\$ 500 million in 2011. Other company belong to the Sanitary ceramics sector had sales of US\$140 million; another one at the electrical and gas devices industry with sales near US\$ 250 million; another one at the canned food had sales of US\$ 151 million; and one belonging to the animal feed with sales over US\$ 700 million.

In order to measure maturity in knowledge management, an instrument was built; it has a scale based on the three levels of maturity. Additionally, two intermediate points were considered. The first one indicates if the answers are located between Ad hoc and Limited, and Formalized and Predictable; the second one determines if the answers are between that last level and Integration, Synergy and Autonomy (Essmann and Du Preez, 2009).

To measure innovation performance, we used the instrument created by Alegre et al (2005). This one suggests designing a scale oriented to comparing own results in product innovation and marketing strategies to the ones from the competition within the last three years using the following terms: Very superior, Superior, Similar, Inferior and Very Inferior (Urgal et al, 2011).

After this, a contingency table was built and Pearson's Chi Square distribution was calculated and its asymptotic bilateral significance. When the significance probability is lower than 0.05, it can be stated that there is statistical associativity among the variables (Sánchez, 2005).

7. RESULTS

Table 1 presents the results of the Chi Square tests. For these sample companies not all the evaluated components showed that knowledge management maturity can be associated with innovative performance.

It can be observed that product innovation is mainly supported by the Processes key area, particularly at Gathering, Application, Dissemination and Creation; they constitute the primary activities of knowledge management at any organization.

It is remarkable that there is not an association between Product Innovation and the Technology key area; the KM Technologies and KM Technologies Administration variables are usually considered as very relevant (Pyka, 2002). Instead, there is evidence of a relation with Organizations and People, and Interpretation, specifically with weak variables like the Incentive System, the KM Strategy and the Meaning Management. In other words, the contribution of KM to product innovation consists in intervene the strategic field by formulating the KM strategy, implementing operational-type practices related to knowledge processes, implementing an incentive system and finally, introducing new values and beliefs and provide tools for the individuals to validate their personal and group interpretations of the collected data.

This suggests that, in order to achieve results, it is necessary to combine the KM Functionalist perspective with the Interpretative since it is not enough to mature some of the variables of the traditional key areas (Processes and Organizations and People) but also the Meaning Management; doing this implies the intervention on the value and belief systems of the people (and this is probably the most relevant finding of this research due to the little empirical evidence supporting its association with innovation performance).

Table 1. Associativity Tests among the knowledge management key area components and innovative performance of marketing and product.

Knowledge Management Maturity Model		Marketing Innovation		Product Innovation	
Key Areas	Variables	Pearson's Chi square	Asymptotic bilateral significance	Pearson's Chi square	Asymptotic bilateral significance
Organization and People	Trust	15,671	0,476	13,842	0,311
	T-Shaped Skill	23,894	0,092	11,681	0,472
	Incentive System	28,064	0,031*	25,954	0,011*
	KM strategy	31,791	0,011*	22,065	0,037*
Interpretation	Meaning management	20,976	0,179	26,327	0,010*
	Action management	10,226	0,596	13,928	0,125
Processes	Knowledge creation	16,775	0,400	22,956	0,028*
	Knowledge gathering	46,254	0,000**	39,386	0,000**
	Knowledge application	21,273	0,168	32,687	0,001**
	Knowledge dissemination	15,775	0,469	22,837	0,029*
Technology	Attitude towards KM technologies	21,119	0,174	16,379	0,175
	KM technologies administration	20,415	0,202	16,049	0,189
	KM technologies	26,616	0,046*	19,229	0,083

* p<0,05 ; ** p<0,01

Source: Own elaboration.

Concerning marketing innovation, it can be observed its link to the Gathering process and the KM Technologies; this indicates that the introduction of changes in the commercialization is an activity derived mainly from data gathering from external sources supported by information technologies. It reveals a major role of the KM Functionalist perspective.

The above contrasts with observations in product innovation. It seems to be a knowledge building process oriented towards the inner company; it is centered on the people and demands interventions of the value and belief system (individual and group) which share spaces to interact, create and exchange their own data interpretations.

The truth is that in both cases, product and marketing innovation, there is an association with the Incentives System and KM Strategy. This is a relevant fact that shows the importance of rewarding symbolic or economically knowledge

creation or exchange, and clearly and explicitly defining the core of knowledge processes (technology or people).

On the other side, there is a group of variables which present no association with product and marketing innovation. Among these, Trust stands out; it is strongly linked to promoting informal relations; some authors like Wang and Ahmed (2003) and Nonaka and Konno (1998) defend this.

In this list, we also have the Action Management and the T-Shaped Skill; it suggests moderating the importance given to decision-making protocols, training, the interdisciplinary - interfunctional job encouragement and personnel rotation.

Also, there is not any association between both types of innovation and Technologies' management and Attitude towards them. This might indicate that it is not necessary to emphasize the design of a complex KM technology system or promote an advanced expertise of them; it might be enough to just implement the ones playing an important role in the Gathering (since it positively influences product and marketing innovation).

CONCLUSIONS

Product innovation has a relation with a wide number of variables in the KM maturity model, particularly with the ones belonging to the Process key area, the Incentive System, the KM Strategy and the Meaning Management. This shows that the soft variables of the KM maturity model have more influence; variables close to the cultural and organizational components over the technological (which influence is basically none).

On the other hand, marketing innovation is related to a smaller number of variables, particularly to the Gathering, the KM Technologies, the Incentive System and the KM Strategy. This indicates that the developments in commercialization techniques demand a bigger emphasis on external data collecting where the technological infrastructure is fundamental.

One of the most important findings is that there is evidence of an association between Product innovation and Meaning Management. This reveals that there is a complementary relation between the KM Functionalist and Interpretative perspectives.

Concerning recommendations, it is expected that KM models oriented towards product and marketing innovation mainly focus on formulating a KM Strategy

and an Incentive System, on implementing operational –type practices leading to outline the Gathering and Application of knowledge; models that introduce new values and beliefs supporting Interpretation and provide tools so that the people can validate their data interpretations.

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Appendix A. Organizations and People key area in Maturity Scale.

Variables	Maturity levels		
	Ad hoc y limited	Formalized and predictable	Integration, synergy and autonomy
Trust	Individuals have little trust in their coworkers and managers' skills and intentions	Trust is promoted through actions encouraging empowerment, informal relations and physical proximity.	People fully trust in their coworkers and managers' skills and intentions and the mechanisms promoting trust are constantly improved and these have been institutionalized.
T-Shaped Skills	People show little degree of expertise in their work area and a limited understanding of its relation with their coworkers' own tasks	Training in specific work areas is encouraged as well as interdisciplinary and interfunctional jobs and personnel rotation.	People have a high degree of expertise at their specific work area and a high degree of understanding of its relation with their coworkers' own tasks; interdisciplinary and interfunctional jobs and personnel rotation are institutionalized practices.
Incentive systems	The organization does not have clear mechanisms to compensate knowledge creation and exchange.	The organization has defined policies and mechanisms to compensate symbolic and economically knowledge creation and exchange.	People create and share knowledge motivated mainly by the symbolic compensation and the incentive system is constantly improved.
KM strategy	The organization does not have a formal strategy for managing knowledge.	The organization has defined and implemented a formal knowledge management strategy oriented to technology.	The knowledge management strategy is oriented towards personnel rather than technology; it is constantly monitored as well as knowledge creation and exchange operational activities.

Source: Own Elaboration.

Appendix B. Processes key area in Maturity Scale.

Variables	Maturity levels		
	Ad hoc y limited	Formalized and predictable	Integration, synergy and autonomy
Creation	People develop new knowledge by using personal criteria; the organization does not define methods, norms, standards or spaces with this respect.	The organization has defined the key knowledge areas; innovation teams, practice communities and virtual networks have been created; indicators are used for measuring.	People from all departments and hierarchies (even outsiders) generate knowledge towards the key knowledge areas from participation in the established spaces which are constantly improved.
Gathering	People identify and collect data using personal criteria and store them in personal repositories.	The organization has defined the external knowledge key sources, a storage protocol and institutional data repositories; indicators are used for measuring.	People permanently gather information from the defined external sources; they store the information according to the protocols in the institutional repositories; this process is constantly improved.
Dissemination	People have restrictions to Access the organization's information which is stored in institutional repositories; there are no diffusion mechanisms available.	The organization has defined standards to grant the individuals access to the institutional information; informative bulletins are sent according to each individual's needs. Indicators are used for measuring.	People permanently access institutional information. Managing staff constantly reconsider the criteria to grant sensible information. People read the informative bulletins which are frequently updated and improved.
Application	People have difficulties for absorbing and using data and information	The company has defined Learning by Doing strategies and specific process and product innovation projects are developed. Indicators are used for measuring.	Individuals easily absorb knowledge and use it to solve daily issues and generate innovation. The organization constantly improves the Learning by Doing strategies and the innovation evaluation standards.

Source: Own Elaboration.

Appendix C. Technology key area in Maturity Scale.

Variables	Maturity levels		
	Ad hoc y limited	Formalized and predictable	Integration, synergy and autonomy
Knowledge Management Technologies	Information technology tools (such as text processors, presentation software, e-mail server data sheets) have been implemented to improve staff's efficiency at the workplace.	Technology to locate experts, document, store and diffuse internal knowledge have been implemented; also people's interaction is encouraged through yellow pages, intranet, corporate website, Datawarehouse, Groupware and Lerant lessons.	Technologies to collect external information, dynamize learning and solve problems have been implemented; among these, there are the competitive intelligence, data mining, expert systems, artificial intelligence, simulators and Workflow.
KM Technologies Administration	In some organizational processes, the existing information technologies are used to develop initiatives or KM pilot projects.	A knowledge management technology system has been designed and implemented. This can be accessed through the organization's website or intranet.	Knowledge management technologies are well integrated to the organization's business processes. The technological infrastructure is constantly improved.
Attitude towards KM Technologies	Individuals are skeptical regarding technologies but possess basic training on it.	Individuals work hard for adopting information technologies and easily manage them.	Individuals are very proactive; they possess advanced knowledge on current and potential technological applications.

Source: Own Elaboration.

Appendix D. Interpretation key area in Maturity Scale.

Variables	Maturity levels		
	Initial	Defined	Optimized
Meaning management	Individuals interpret and give sense to data and information in a personalized way based on their own experience.	The organization implements strategies leading to introduce values and beliefs supporting interpreting. The organization has defined quantitative and qualitative techniques supporting individual data and information interpreting.	Individuals incorporate the organization's data and information values and beliefs supported by the established techniques; interpretations are validated inside the groups.
Action management	Individuals make decisions based on personal interpretations of the data and information.	The organization has defined individual or group decision making protocols based on the interpretations derived from quantitative and qualitative techniques defined by it.	Individuals make decision according to the established corporate protocols which are constantly updated and improved. Decision making is frequently documented and evaluated.

Source: Own Elaboration.