Descriptors for Technology Key Area in a Knowledge Management Maturity Model

Luciano Straccia[1,2], María Florencia Pollo-Cattaneo[2]

[1]Universidad Argentina de la Empresa, Buenos Aires, Argentina
[2]Universidad Tecnológica Nacional, Buenos Aires, Argentina

Abstract
Knowledge is a fundamental factor in organizations adding value to information management. Knowledge management must be carried out considering several aspects called knowledge views: people, organizational aspects, activities and processes, technology, and knowledge presentation and measurement. This paper analyzes the Knowledge Management Measurement. For the measurement, there a several works' lines: indicators and models for evaluating KM and models based on the level of maturity. This paper focuses on the maturity models, analyzing knows maturity models, his maturity levels, and his key area; the models analyzed are G-KMMM, Nutresa model, Ruta N Corporation model, and De Freitas model. This work uses the 5 maturity levels of G-KMMM (initial, aware, defined, managed, and optimized), proposes 4 key areas: people, organizational aspects, process, and technology, and 3 sub-areas for technology key areas: infrastructure and technological elements, use and appropriation of ICT, and information management. Finally, the paper proposes descriptors for these subareas for each maturity level and a questionnaire to assess each descriptor.

Keywords
Knowledge Management, Measurement, Maturity Model

1. Introduction

Knowledge makes sense of information incorporating the tacit implications behind information and knowledge management (KM) is already an indispensable practice for organizations. One of the fundamental approaches or views of knowledge management is measurement. Due to the characteristics of KM, it is complex to make exact quantitative measurements of it, but it is possible to make approximations that allow the organization to determine the current state of KM. Having this approximation will help to guide the organization in a process of continuous improvement and innovation.

One of the most recognized models to evaluate the state of knowledge management in organizations, based on maturity models, is the General Knowledge Management Maturity Model. This model proposes to approach the assessment in 3 areas: people, processes, and technology. Other authors recommend the use of different key areas. De Freitas presents a model that expands to 6 key areas with special emphasis on technology and knowledge representation.

ICAIW 2023: Workshops at the 6th International Conference on Applied Informatics 2023, October 26–28, 2023, Guayaquil, Ecuador
lstraccia@frba.utn.edu.ar (L. Straccia); fpollo@frba.utn.edu.ar (M. F. Pollo-Cattaneo)
0000-0002-1183-7944 (L. Straccia); 0000-0003-4197-3880 (M. F. Pollo-Cattaneo)

This paper proposes to investigate the most recent literature looking for maturity models to compare them with the KMMM, identifying new contributions and analyzing the different elements of a maturity model: maturity levels, key areas, and descriptors.

This work presents theoretical background on knowledge management and its measurement, including types of strategies for knowledge management measurement (in section 2), the presentation and analysis of maturity models for Knowledge Management Measurement (in section 3), and the analysis and proposal from different elements: maturity level (in section 4), key areas (in section 5) and descriptors (in section 6). Finally, section 7 presents the conclusions.

2. Background

This section presents the theoretical background of knowledge management and especially its measurement. First, the concept of Knowledge Management is presented (in subsection 2.1), and then Knowledge Management Measurement (2.2).

2.1. Knowledge Management

Knowledge management (KM) is a concept about how to create and use knowledge [1] that integrate multiple disciplines [2]. Perez and Urbaez [3] define it as "a manage-rial approach or discipline that seeks in a structured and systematic way to take advantage of the co-knowledge generated to achieve the organizational objectives and optimize the decision-making process".

Many authors emphasize the importance of knowledge at the economic level, not only in organizations but in society in general. Gibbs et al. [4] define knowledge as "any sentence, procedure or object that can be property (patent, publication) and become an economic resource, or a commodity in the market". From this definition can be stated that the knowledge found within the organization can be translated into an economic value. At the organizational level, Levison et al. [5] analyze that: "Today, as a strategic way to obtain better results, society, and work organizations are forced to focus their actions towards a new order of things, in which knowledge plays a significant value as a guarantee of organizational success and human talent is considered as the most important capital for the achievement of their goals".

Ackoff [6] proposes a DIKW, in which each concept adds value to the previous one: data, information, knowledge, and wisdom. The data is a simple observation of the state [7], a raw, simple, and discrete fact [8, 9]; information can be defined as a function that receives data, makes sense of it in a specific context and return information; and knowledge can be defined as a function that makes sense of information incorporating the insights [10], considering that the term “insight” represents the tacit implications behind information. According to Davenport [7], knowledge is a "mixture of structured experiences, values, and non-contextual information that provides a framework for evaluating new experiences and information". Finally, "if knowledge is subjected to value judgments and endowed with ethics, it becomes wisdom" [11].

2.2. Knowledge Management Measurement

Trevisan [12] highlights the importance of perceiving results, but also the difficulties in measuring knowledge management. Bertollo [13] states that "the idea of measuring and evaluating

knowledge (...) is recent because accounting systems do not present appropriate mechanisms for treatment, measurement, and evaluation of intangible assets (...) Likewise, the quantification of the financial return on the knowledge asset is also considered difficult and complex, this is only possible in an indirect way, through global performance indicators" [14].

Meanwhile Probst et al. [15] affirms that: "the idea that knowledge can be measured leads to expect objectivity where there can only be approximation". Rodriguez Calvo et al. [16] state that "measurement systems can only offer approximations about the behavior of this asset (knowledge) in the organization, due to its intangible nature".

Lopez Portillo [17] states that the measurement of KM is one of the least developed [18] or researched [19] topics and that "it is very important to establish performance measures at the different stages of KM implementation, and even from the beginning so that its effectiveness can be identified". For Lopez Portillo, it is possible to implement improvement actions based on objective judgments associated with the contribution that KM makes to the institution's strategic objectives [20, 21].

According to [22], a proper performance measurement system should be established and adopted throughout the organization and should not only be limited to measuring knowledge, experience or individual employee performance. Consequently, the lack of a correct knowledge assessment may result in ignorance of the value that knowledge has, or a duplication of efforts may occur [23].

Gomes de Souza [24] states that for the evaluation of knowledge management, there are several lines: use indicators, general models, and models based on maturity levels.

Most of the measurement models based on indicators do not measure knowledge management but intellectual capital. The use of the concept of intellectual capital grew in the last years of the 20th century. Euroforum [25] defines intellectual capital as the set of assets of a company that, despite not being reflected in traditional financial statements, generate value for the company in the future. Following Lev [26] and Sanchez Medina et al. [27], in this paper the term "intellectual capital" is preferred over other terms as intangible assets or knowledge assets. Some of the more traditional measurement models in the knowledge management and intellectual capital literature are Skandia Navigator, Intelect, Intangible Assets Monitor, Balance Scorecard, and Technology Broker.

Oliveira [28] summarizes general knowledge management models such as Bukowitz and Williams and the Balance Scorecard model. The first one is a knowledge management measurement model but does not use a maturity model, while the second one is an intellectual capital measurement model. The model proposed by Bukowitkz and Williams [29] is called Knowledge Management Diagnosis (KMD) and allows an analysis of knowledge management based on activities. For each of the activities involved in Knowledge Management, a score associated with the fulfillment of an activity descriptor is assigned and then, the model totalizes the assigned score [30, 31]. In this case, an indicator associated with knowledge management (and not intellectual capital) is generated.

Finally, the models associated with maturity level is presented in the next section.

3. Maturity Model

This section presents the concept of the Maturity Model (in subsection 3.1), the presence of Maturity Models in current literature (in subsection 3.2), and the components of a maturity model (3.3).

3.1. Concept of Maturity Model

The concept of maturity is defined by Khoshgoftar [32] as "the state in which an organization is in the perfect condition to achieve its objectives". For Diaz Jaimes and Ortíz Pimento [33], maturity "comprises the development from an initial state to a more advanced state defined in terms of good practices, which is reached by going through many intermediate or transition states in the maturity path" and a maturity model assumes the evolution of the organization by stages, with objective patterns that describe them, allowing the comparison with an objective and a valid metric for a group of organizations with common characteristics [33, 34]. A maturity model is a conceptual framework that defines maturity levels in certain areas of interest[1].

For Fraser and Moultrier [35] the following components must be present in any maturity models: many maturity levels, a descriptive name for each level, a generic description of each level, many dimensions or process areas (PA), many elements or activities that belong to each PA and a description for each activity and the detail of how it can be carried out.

3.2. Maturity Model in Literature

In recent years, our research group has conducted several systematic reviews of the academic literature and papers associated with knowledge management activities and processes [36, 37] and technology and knowledge representation [38, 39, 40] have been presented. In these reviews, works related to measurement through maturity models have been found and it is presented in this section.

Galindo-Acevedo et al. [41] propose a knowledge management model and perform the maturity assessment of its implementation in an organization through the maturity model of Pee et al. [42] called General Knowledge Management Maturity Model (G-KMMM). This model was selected by Montañez-Carrillo et al. [43] as the most appropriate for performing knowledge management diagnostics in a comparative analysis among 24 maturity models proposed in the academic literature between 2001 and 2016.

In other work, Gomes de Souza [24] conducts research whose general objective was to investigate the level of maturity of Knowledge Management in complex university organizations based on the opinion of teachers and technicians of the UFRPE, using Batista's Model of Knowledge Management for Public Administration [44]. Batista's model opts to use the model adapted by the Asian Productivity Organization (APO). APO proposes the G-KMMM model[2].

Furthermore, Santos y Bastos [45] analyze the maturity of knowledge management in the Public Administration with the application of the methodology developed by Helou [46], which adapted the models proposed by APO to evaluate the maturity of knowledge management in

[1]Project Management Institute: Organizational Project Management Maturity Model Knowledge Foundation.
[2]APO: Knowledge Management. Tools and Techniques Manual. Tokyo: Asian Productivity Organization.

the Public Administration. The authors present the different variables used and the evaluation instrument. As mentioned above, APO currently proposes the use of G-KMMM.

Moreover, Vera Torres [47] presents several knowledge management maturity models, with special emphasis on the works of Yepes et al. [48] and Arias-Perez et al. [49]. Durango Yepes' model is based on the CMM model that proposes the same maturity levels as G-KMMM. Escrivao and Silva [50] present a systematic literature review associated with knowledge management maturity models. They present several factors of the models, finding: activities, technology, culture, management support, infrastructure, human resources management, organizational knowledge, learning, strategies, and measurement. Some of these factors are identified as key success factors. However, it does not make a clear proposal of a maturity model, although it recommends continuing research on models associated with CMM (Capability Maturity Model), such as the G-KMMM.

All works previously presented propose the use of the General Maturity Model Measurement, however some works use other models: Bermudez-Rodriguez et al. [51] propose the Nutresa model [49] and Bedoya and Crespo Jaramillo [52] use the Ruta N Corporation model. All models are organized into 3 components which are presented in section 3.3, and the details for each maturity model are presented and analyzed in the next sections.

3.3. Components of a Maturity Model

Following the Fraser and Moultrier proposal [53] presented in section 3.1, all the models detailed in section 3.2. are organized into 3 components: maturity levels, key process areas, and the descriptors for each key process area in each level, as shown in table 1. A descriptor is a brief description that accompanies a level on a rating scale and summarizes the degree of success or type of performance expected to be achieved at that level.

Table 1
Components of a maturity level

Level	Key Area 1	....	Key Area N
Level 1	descriptor	descriptor	descriptor
...	descriptor	descriptor	descriptor
Level N	descriptor	descriptor	descriptor

4. Maturity Levels

This section presents the maturity level proposed in the literature (in subsection 4.1) and its comparative (in subsection 4.2).

4.1. Maturity Levels in Literature

The maturity models presented in the previous section (G-KMMM, Nutresa, and Ruta N) agree to propose 5 maturity levels. Bustelo Ruesta and Amarilla Iglesias [54] present a survey of other

maturity models identifying that most of them also propose 5 levels: Infosys KMMM, Siemens KMMM, KPQM, Generic KM, KMS, KNM, KMMM APQC, KPMG, TCS 5iKM, STEPS.

G-KMMM proposes the following levels: initial (little or no intention to formally manage organizational knowledge), aware (organization is aware of and has the intention to manage its organizational knowledge, but it might not know how to do so), defined (organization has put in place a basic infrastructure to support KM), managed (KM initiatives are well established in the organization) and optimized (knowledge management is deeply integrated into the organization and is continually improved upon and it is an automatic component in any organizational process).

The Nutresa model has the following levels: initial (there are informal KM practices, tacit and individual knowledge prevails and there is no alignment of KM initiatives with the business strategy), exploratory (there is an initial definition of KM for the organization and the implications of its implementation are considered, and pilot projects are developed), used (the organization implements formal KM practices, which are linked to strategy, processes and culture), managed (advanced and standardized KM practices are implemented, followed up and controlled through indicators, and business benefits are generated from knowledge) and innovation (KM practices are continuously improved and optimized, KM adapts flexibly to new business requirements and leverages innovation).

The 5 levels of the Ruta N Corporation model are: nonexistent (no readiness analysis is performed), incipient (there are sporadic and reactive actions), in process (actions with an experimental or formative step), conformed (actions with a standard step by step and management is carried out), consolidated (actions with a standard step by step and there are continuous improvement processes).

4.2. A comparative of Maturity Levels

This section presents a comparison between the maturity levels of the models presented in subsections 3.2 and 4.1.

In the Nutresa model, the initial level already incorporates some knowledge management practices, unlike the other models, where the initial level is about the non-existence of aspects and interest in knowledge management. These initial practices in the Nutresa model are informal and not aligned with the business strategy.

All models present levels related to the intention or awareness of managing knowledge and the definition of pilot, experimental, or training experiences. This experimental level is called aware in G-KMMM (level 2), exploratory in Nutresa (level 2), and process in Ruta N (level 3).

Levels 4 in all the models analyzed are linked to the existence of standardized and established practices. Level 5 of the different models is linked to continuous improvement. Finally, both the G-KMMM and Nutresa model present intermediate levels of implementation of some aspects of knowledge management in a formal way, overcoming the informality of the first level and the exploratory notions of the second level, constituting a first step of formalization.

A comparison of maturity levels of the analyzed models is presented in table 2.

Considering that G-KMMM is the most accepted model in the evaluation of knowledge management, the levels of this model will be considered in this work and all the information that the Nutresa model considers in level 1 is incorporated into level 1 of the G-KMMM reference.

Table 2
Comparison maturity levels of models

G-KMMM	Nutresa	Ruta N
Level 1: initial		Level 1: nonexistent
	Level 1: initial	Level 2: incipient
Level 2: awareness	Level 2: exploratory	Level 3: information
Level 3: defined	Level 3: used	
Level 4: managed	Level 4: managed	Level 4: conformed
Level 5: optimized	Level 5: innovation	Level 5: consolidated

Regarding the Route N model, since the next sections will address technological aspects that this model does not consider, there is no problem with the differences in the proposed levels.

5. Key Areas and Sub-areas

This section presents a key areas proposal (in subsection 5.1) and their sub-areas (in subsection 5.2).

5.1. Key Areas

This section presents key areas considering the works found in the literature and incorporates De Freitas' proposals, which present a critical view of G-KMMM.

In G-KMMM the following key process areas are proposed: people, processes, and technology. For De Freitas [53], the G-KMMM model "does not contemplate all the elements", identifying the absence of consideration of the knowledge management strategy, networks, and information management. The G-KMMM model considers 3 key areas, while the De Freitas' model expands to 6 key areas: knowledge management strategies, people, processes, technology, networks, and information management. The knowledge management strategy is "the one that provides the basis for shaping the three components mentioned (people, processes, and technology)" [54]; this key area is also proposed by Montañez-Carrillo et al. [55]. Regarding information management, it is "the set of activities carried out to control, store and, subsequently, adequately retrieve the information produced, received or retained by any organization in the development of its activities" [54]. The notion of information management is also related to the level of information proposed in Ackoff's pyramid.

Nutresa's model organizes the evaluation of knowledge processes, technology, strategy, and culture. Although Nutresa does not consider the key area "people", it considers its aspects within the strategy and culture areas, where they are proposed as variables called "knowledge management strategy" and "attitude of employees", among others. From the identification of these variables, it can be pointed out that they make proposals linked to the individual and people aspects of the organization, and also to organizational aspects, just like the other models. The model is built from an analysis of different models: KPMG, KMMM, V-KMMM, KPQM, 5iKM3, S-KMMM, KMMM interpretative, I-KMMM, G-KMMM, KNM, KMMS, KMME and Brazilian KMMM.

Ruta N model proposes to organize the evaluation for different knowledge management activities: identify, create, store, share, and use. While most of the models propose a key process area, Ruta N proposes to consider each activity as a key area.

The table 3 shows a comparison between the different areas proposed by the different models.

Table 3
Comparison key areas in models

G-KMMM	Nutresa	Ruta N	De Freitas
People			People
	Strategy; Culture		Strategy
Processes	Processes	Each activity	Processes
Technology	Technology		Technology; ICT; Information Management

There is agreement in considering the following key areas: people, processes, organizational aspects (added or split, depending on the model), and technological aspects (added or split, depending on the model). The classification associated with technology by De Freitas is considered in the subareas presented in the next section; likewise, the possibility of considering strategy and culture as subareas in organizational aspects. These key areas are presented in Figure 1.

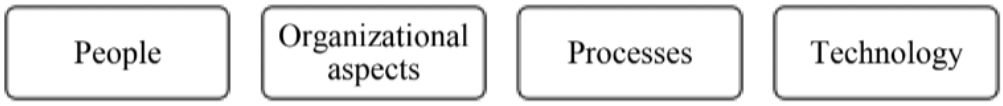

Figure 1: Key Areas

5.2. Sub-areas

This subsection aims to identify a sub-area for each of the areas mentioned in the previous subsection. The Ruta N model does not present aspects associated with people. The Nutresa model does not present a key people area, but as mentioned above, it considers them within Culture and Strategy, considering the following aspects: commitment of managers and the attitude of employees. De Freitas does not propose subareas for people. The summary of subareas for key area people is presented in Figure 2.

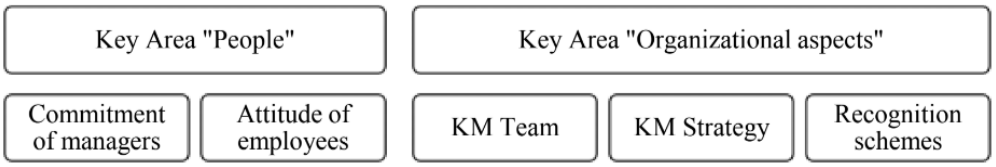

Figure 2: Sub-areas for key areas “People” and “Organizational aspects”

Meanwhile, regarding organizational aspects, The Ruta N and G-KMMM models do not present this area. The Nutresa model considers the knowledge management team, the knowledge management strategy, and the recognition schemes. De Freitas proposes descriptors associated with the KM strategy. The summary of subareas for key area organizational aspects is presented in Figure 2.

In the key area " processes", the Nutresa model proposes each of the knowledge management activities as sub-areas. The same is done in the G-KMMM model. De Freitas does not propose sub-areas. In [37], the authors of this work propose knowledge management activities that complement those proposed by the known models: learning, retrieval, acquisition, dissemination, socialization, representation and structuring, creation, and identification. These activities can be considered sub-areas for the key area “process” and it is presented in Figure 3.

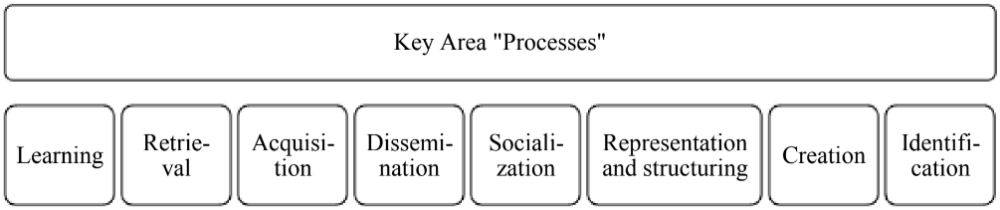

Figure 3: Sub-areas for key area “Processes”

Related to technology, the Ruta N model does not consider it, and G-KMMM presents technology areas but does not present subareas. Meanwhile, Nutresa divided the technology key area into 2 groups (called variables): ICTs for KM and appropriation of ICTs. The first group corresponds to the existence of technological infrastructure in the organization, while the second corresponds to the use of technologies by workers. It can be verified that the descriptors proposed by G-KMMM associated with technology can be associated with infrastructure and others with the use and appropriation of technology for knowledge management (first and second group of Nutresa, respectively).

Finally, De Freitas proposes 2 areas associated with technology: technology for KM and information management. The first contains the same descriptions as G-KMMM and the information management constitutes an original group.

Then, it can be observed that following the previous analysis it is feasible to identify 3 groups (sub-areas) that it presented in Figure 4: a) infrastructure and technological elements; b) use and appropriation of technology for knowledge management; and c) information management.

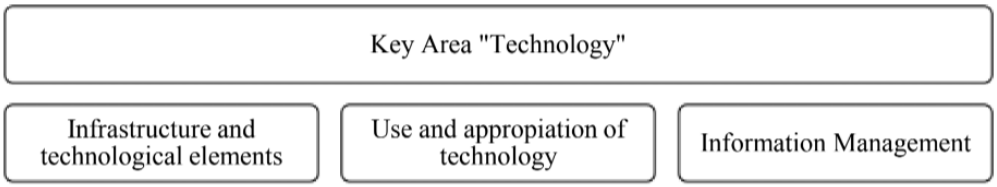

Figure 4: Sub-areas for key area “Technology”

6. Descriptors for Technological Key Areas

As mentioned in subsection 3.3, a maturity model should include maturity levels, key areas (and sub-areas as mentioned in section 5), and descriptors. Given the scope of this work, this section presents only the descriptors associated with technology.

6.1. Descriptors

Considering the maturity levels mentioned in section 4, and the subareas proposals in section 5, the table 4 shows the descriptors proposed by the different models presented in section 3.

Table 4
Descriptors for key area technology

Infrastructure and Technological Elements	**Use and Appropriation of ICT for KM**	**Information Management**
Level 1: the business only has Word, Excel, PowerPoint, and email tools to support KM (Nutresa)	Level 1: employees are aware of the existence of ICTs that support KM in the business (Nutresa)	Level 1: little or non-existent information management intentions (De Freitas)
Level 2: the business identifies and plans the implementation of ICTs that support KM (Nutresa)	Level 2: employees are aware of the importance and scope generated using ICT that supports KM in the business. (Nutresa); knowledge management pilot projects have been initiated (not necessarily by management initiative) (G-KMMM)	Level 2: the organization is aware of and intends to manage the information but may not know how to (De Freitas)
Level 3: ICT for KM is enabled, specifically to support collaborative work and the identification of experts in each business (Nutresa); there is a basic knowledge management infrastructure (G-KMMM)	Level 3: employees use ICTs that support KM frequently, finding the benefits in their work (Nutresa); some knowledge management projects have been implemented at some levels of the organizational pyramid (G-KMMM)	Level 3: the processes for information management have been formalized (De Freitas)
Level 4: there is a cross-cutting technological platform for all businesses, which integrates the acquired knowledge (Nutresa); throughout the organization knowledge management systems are fully functioning (G-KMMM)	Level 4: the permanent use of ICTs fosters a shared knowledge platform in the business, which stimulates collective learning (Nutresa); the use of knowledge management systems is at a reasonable level (G-KMMM)	Level 4: the initiatives on information management are established in the organization (De Freitas)
Level 5: there is a transversal technological platform for the business that facilitates KM and innovation, promoting collaborative work with internal and external entities (Nutresa); the current knowledge management infrastructure is continuously improved (G-KMMM)	Level 5: They also find new ways of use and quickly adopt the new ICTs that are implemented in the business (Nutresa)	Level 5: All the organization's information is managed. Information management is integrated with the organization's functional processes. It is in continuous improvement (De Freitas)

6.2. Questions for descriptors

This subsection presents questions whose answers allow the identification of compliance with the descriptors defined in the previous subsection.

Considering the order proposed in Ackoff's pyramid, the questionnaire of the sub-area associated with information is presented first, followed by those related to knowledge management.

The questions proposal for the descriptors in Information Management are:

1. Is there information management intention in the organization?
2. If there are intentions, does the organization know how to manage information?
3. Is the information management process formalized?
4. Are information management initiatives formally established in the organization?
5. Is information management integrated into functional processes?
6. Is there a continuous improvement process for information management?
   The questions proposal for the descriptors in Infrastructure and Technological Elements are:
7. What is the technology implemented for KM?
8. If no technology is in place, are there plans for the implementation of ICT?
9. Are the experts in each business identified?
10. Is there a transversal technological platform for all the company's businesses?
11. Does the platform integrate the knowledge acquired in the different businesses?
12. Does this transversal technological platform facilitate innovation?
13. Is collaborative work with external entities encouraged?
14. Is there a continuous improvement of the knowledge management infrastructure?
    And finally, the questions proposal for the descriptors in Use and Appropriation of ICT are:
15. Are there some knowledge management projects?
16. If there are KM projects, are they in pilot status?
17. Are employees aware of the existence of ICTs that support knowledge management in the company?
18. Are employees aware of the importance of using ICT that supports KM in the business?
19. Do employees frequently use ICTs that support knowledge management?
20. Is the use of knowledge management systems at a reasonable level?
21. Do employees find the advantages in their work when using ICTs that support knowledge management?
22. Is there collective learning?
23. Do employees find new ways to use and quickly adopt new ICTs that are implemented in the company?

7. Conclusions

This paper analyzes the Knowledge Management Measurement and the maturity models for his evaluation, analyzing knows maturity models, his maturity levels, and his key areas; the

models analyzing are G-KMMM, Nutresa, Ruta N Corporation, and De Freitas. This work uses the 5 maturity levels of G-KMMM (initial, aware, defined, managed, and optimized), proposes 4 key areas: people, organizational aspects, process, and technology, and 3 sub-areas for technology key areas: infrastructure and technological elements, use and appropriation of ICT, and information management. Finally, the paper proposes descriptors for these sub-areas for each maturity level and a questionnaire to assess each descriptor.

As future lines of work, it is proposed to include descriptors and a questionnaire for the other key areas and propose the possible relationship between the questions, their answers, and each descriptor.

References

[1] D. Farfán Buitrago, M. Garzón Castrillón, La gestión del conocimiento, Universidad del Rosario, Facultad de Altos Estudios de Administración y Negosioc, 2006.
[2] K. Wiig, Enterprise knowledge management, 2007.
[3] V. A. Pérez, M. F. Urbáez, Modelos teóricos de gestión del conocimiento: descriptores, conceptualizaciones y enfoques, Entreciencias: diálogos en la Sociedad del Conocimiento 4 (2016) 201–227.
[4] B. Gibbs, E. Hadley-Kershaw, B. Nerlich, W. Pearce, H. Salvadurai, A. Spencer, J. Tsouvalis, The 2013 conference organising committee was, 2013.
[5] Y. O. Levison, M. E. González, L. A. Salguero, Propuesta para construcción de un modelo de gestión del conocimiento en una unidad de planificación y desarrollo de la upel, 2013.
[6] R. L. Ackoff, From data to wisdom, Journal of applied systems analysis 16 (1989) 3–9.
[7] T. H. Davenport, L. Prusak, Information ecology: Mastering the information and knowledge environment, Oxford University Press, USA, 1997.
[8] G. D. Bhatt, Knowledge management in organizations: examining the interaction between technologies, techniques, and people, Journal of knowledge management 5 (2001) 68–75.
[9] H. Florez, M. Sánchez, J. Villalobos, iarchimate: a tool for managing imperfection in enterprise models, in: 2014 IEEE 18th international enterprise distributed object computing conference workshops and demonstrations, IEEE, 2014, pp. 201–210.
[10] Z. Li, On a factorial knowledge architecture for data science-powered software engineering, in: Proceedings of the 2020 4th International Conference on Software and e-Business, 2020, pp. 20–24.
[11] M. Pollo-Cattáneo, Resolviendo problemas en los sistemas de información: enfoque para informáticos, Centro de Estudiantes de Ingeniería Tecnológica, CEIT (2012).
[12] L. C. Trevisan, Fatores críticos de sucesso relacionados à gestão do conhecimento: um estudo em organização de desenvolvimento de software., 2019.
[13] D. L. Bertollo, As sete dimensões da gestão do conhecimento das empresas de material plástico do rio grande do sul, 2020.
[14] W. B. Damiani, Gestão do conhecimento: uma comparação entre empresas brasileiras e norte-americanas, 2005.
[15] G. Probst, S. Raub, K. Romhardt, E. Fernández, Administre el conocimiento, Pearson Educación de México, 2001.

[16] M. León Santos, G. Ponjuán Dante, M. Rodríguez Calvo, Procesos estratégicos de la gestión del conocimiento, Acimed 14 (2006) 0–0.
[17] H. P. L. PORTILLO, et al., Gestión y medición del conocimiento en organizaciones públicas, 2016.
[18] R. Bose, Knowledge management metrics, Industrial management & data systems 104 (2004) 457–468.
[19] A. Garlatti, M. Massaro, J. Dumay, L. Zanin, Intellectual capital and knowledge management within the public sector. a systematic literature review and future developments, in: Proceedings of the 11th International Conference on Intellectual Capital, Knowledge Management & Organizational Learning ICICKM, 2014, pp. 175–184.
[20] J. P. Girard, S. McIntyre, Knowledge management modeling in public sector organizations: a case study, International Journal of Public Sector Management 23 (2010) 71–77.
[21] E. Vagnoni, C. Oppi, Investigating factors of intellectual capital to enhance achievement of strategic goals in a university hospital setting, Journal of Intellectual Capital 16 (2015) 331–363.
[22] H. G. Chong, Performance measurements for small & medium enterprises (smes), Chong, HG (2003) Performance measurements for small & medium enterprises (SMEs) The International Journal of Condition Monitoring & Diagnostic Engineering Management 6 (2020) 11–15.
[23] Y. Hu, J. Wen, Y. Yan, Measuring the performance of knowledge resources using a value perspective: integrating bsc and anp, Journal of Knowledge Management 19 (2015) 1250–1272.
[24] A. R. G. de Souza Cahú, C. Rosa, S. de Albuquerque, I. C. de Moraes, J. da Silva Correia-Neto, Gestão do conhecimento em organizações públicas complexas: um estudo de caso na ufrpe, Revista dos Mestrados ISSN 2317 (2019) 0115.
[25] E. Bueno, S. Azúa, Medición del capital intelectual: modelo intelect, Instituto Universitario Euroforum Escorial, Madrid (1998).
[26] B. Lev, Intangibles: Management, measurement, and reporting, the brookings institution, Washington DC, USA (2001).
[27] A. J. Sánchez Medina, A. Melián González, J. M. García Falcón, El concepto del capital intelectual y sus dimensiones, Investigaciones europeas de dirección y economía de la empresa (2007).
[28] M. B. d. Oliveira, Gestão do conhecimento e sua relação com indicadores de qualidade de cursos superiores: estudo dos centros universitários do Rio Grande do Norte, Master's thesis, Brasil, 2019.
[29] W. R. Bukowitz, R. L. Williams, Manual de gestão do conhecimento: ferramentas e técnicas que criam valor para a empresa, Bookman Porto Alegre, 2002.
[30] B. R. Betancur Martínez, J. A. Orbes Moreano, Propuesta de un modelo de gestión de conocimiento para el grupo de auditoría tributaria ii de la división de gestión de fiscalización de la dian seccional cali., 2016.
[31] H. Florez, M. Sánchez, J. Villalobos, A catalog of automated analysis methods for enterprise models, SpringerPlus 5 (2016) 1–24.
[32] M. Khoshgoftar, O. Osman, Comparison of maturity models, in: 2009 2nd IEEE International Conference on Computer Science and Information Technology, IEEE, 2009, pp. 297–301.

[33] M. D. P. Díaz-Jaimes, N. R. Ortíz-Pimiento, Revisión de modelos de madurez: estrategia de evaluación del desempeño para empresas de manufactura, Revista UIS Ingenierías 11 (2012) 55–72.
[34] V. N. S. Silveira, Os modelos multiestágios de maturidade: um breve relato de sua história, sua difusão e sua aplicação na gestão de pessoas por meio do people capability maturity model (p-cmm), Revista de Administração Contemporânea 13 (2009) 228–246.
[35] P. Fraser, J. Moultrie, M. Gregory, The use of maturity models/grids as a tool in assessing product development capability, in: IEEE international engineering management conference, volume 1, IEEE, 2002, pp. 244–249.
[36] L. N. Straccia, A. M. Buño, C. Ramacciotti, M. F. Pollo-Cattaneo, Fases propuestas para el diseño y construcción de un modelo de gestión del conocimiento, Desarrollo e Innovación en Ingeniería (2021) 306.
[37] L. Straccia, M. F. Pollo-Cattaneo, A. Maulini, Knowledge management model: A process view, in: International Conference on Computational Science and Its Applications, Springer, 2023, pp. 599–616.
[38] L. N. Straccia, C. Ramacciotti, M. F. P. Cattaneo, Una visión de la tecnología para la gestión del conocimiento: Resultados en la literatura latinoamericana, in: Desarrollo e Innovación en Ingeniería, Instituto Antioqueño de Investigación (IAI), 2020, pp. 135–142.
[39] L. Straccia, M. F. Pollo-Cattáneo, M. Giorda, M. G. Bongiorno, A. Maulini, Architecture on knowledge management systems: Its presence in the academic literature, in: International Conference on Applied Informatics, Springer, 2022, pp. 411–423.
[40] L. Straccia, A. Maulini, M. G. Bongiorno, M. Giorda, M. F. Pollo-Cattaneo, Knowledge representation and technologies in the latin american academic literature, 2022.
[41] L. P. Galindo Acevedo, E. F. Álvarez Pacheco, Propuesta de un modelo de gestión de conocimiento enfocado en el proceso del grupo de servicios administrativos del ministerio de minas y energía, 2019.
[42] L. Pee, H. Teah, A. Kankanhalli, Development of a general knowledge management maturity model [ponencia], 2006.
[43] L. MONTAÑEZ-CARRILLO, J.-P. LIS-GUTIÉRREZ, A propósito de los modelos de madurez de gestión del conocimiento, Revista Facultad de Ciencias Económicas: Investigación y reflexión 25 (2017) 63–81.
[44] F. F. Batista, Modelo de gestão do conhecimento para a administração pública brasileira: como implementar a gestão do conhecimento para produzir resultados em benefício do cidadão, 2012.
[45] V. d. Santos, R. C. Bastos, Avaliação da maturidade da gestão do conhecimento na administração pública, Perspectivas em Gestão & Conhecimento; v. 9, n. 1 (2019); 24-41 24 (2019) 41–24.
[46] A. Helou, A. Abreu, G. Lenzi, Maturidade da gestão do conhecimento para a administração pública, 2015.
[47] L. J. Vera Torres, et al., Diseño de un modelo de gestión del conocimiento mediante el cual se dinamice y promueva la transferencia de conocimiento y el aprendizaje organizacional en la Secretaría de Tecnologías de la Información y las Comunicaciones de la Alcaldía de Armenia., Master's thesis, Maestría en Gerencia de Sistemas de Información y Proyectos Tecnológicos Virtual, 2021.

[48] C. M. Durango Yepes, M. E. Quintero Muñoz, C. A. Ruiz González, Metodología para evaluar la madurez de la gestión del conocimiento en algunas grandes empresas colombianas, tecnura 19 (2015) 20–36.
[49] J. E. Arias Pérez, J. F. Tavera Mesías, D. Castaño Serna, Construcción de un modelo de madurez de gestión del conocimiento para una multinacional de alimentos de una economía emergente, 2016.
[50] G. Escrivão, S. L. d. Silva, Knowledge management maturity models: Identification of gaps and improvement proposal, Gestão & Produção 26 (2019).
[51] S. Bermúdez-Rodríguez, A. Hernández-Ibarra, Diagnóstico del capital intelectual en una empresa maquiladora textil mexicana, Revista Escuela de Administración de Negocios (2019) 57–76.
[52] I. B. Bedoya, S. C. Jaramillo, Propuesta de instrumento para la identificación del nivel de madurez de los procesos de gestión del conocimiento, Gestión de las Personas y Tecnología 12 (2019) 7–22.
[53] V. De Freitas, Modelo de madurez en sistema de gestión del conocimiento, desde un enfoque holístico, Negotium: revista de ciencias gerenciales 13 (2018) 5–31.
[54] C. B. Ruesta, R. A. Iglesias, Gestión del conocimiento y gestión de la información, Boletín del Instituto de Andaluz de Patrimonio Histórico 8 (2001) 226–230.
[55] L. M. Carrillo, J. P. L. Gutiérrez, Medición de la madurez de la gestión del conocimiento en la escuela de ciencias básicas tecnología e ingeniería de la unad, Publicaciones e Investigación 10 (2016) 177–191.