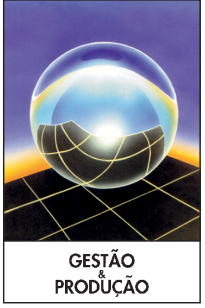
Gest. Prod., São Carlos, v. 26, n. 3, e3890, 2019
https://doi.org/10.1590/0104-530X3890-19

Original Article



ISSN 0104-530X (Print)
ISSN 1806-9649 (Online)

Knowledge management maturity models: identification of gaps and improvement proposal

Modelos de maturidade da gestão do conhecimento: identificação de lacunas e proposta de melhoria

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How to cite: Escrivão, G., & Silva, S. L. (2019). Knowledge management maturity models: identification of gaps and improvement proposal. *Gestão & Produção*, 26(3), e3890. https://doi.org/10.1590/0104-530X3890-19

Abstract: The aim of this paper is to conduct a systematic review of knowledge management maturity models, indicating shortcomings, identifying relevant factors for the models and suggesting improvements. This study can be characterized as a theoretical research based on a systematic literature review. This paper contributed through a review and analysis of existing knowledge management maturity models to bring forth their contributions and drawbacks; the main criticisms and shortcomings of these models and factors relevant to the development of knowledge management maturity were identified, systematic and conceptually, which must be confirmed and explored through empirical research.

Keywords: Knowledge management; Maturity models; Stages; Knowledge management development.

Resumo: *O objetivo deste artigo é fazer uma revisão sistemática dos modelos de maturidade da gestão do conhecimento, apontando lacunas, identificando fatores relevantes e propondo melhorias. Esse estudo pode ser caracterizado como pesquisa teórica baseada em revisão sistemática da literatura. Esse artigo contribui por meio da revisão teórica e da análise dos modelos de maturidade da gestão do conhecimento existentes, identificando contribuições e limitações, principais críticas e falhas desses modelos e os fatores relevantes para desenvolver a maturidade da gestão do conhecimento conceitual e sistematicamente, os quais podem ser confirmados e explorados por meio de pesquisa empírica.*

Palavras-chave: *Gestão do conhecimento; Modelo de maturidade; Estágios; Desenvolvimento da gestão do conhecimento.*

1 Introduction

Knowledge management (KM) has got much attention in academic and professional field in the last decades; particularly the studies concentrate on KM implementation (Abu Naser et al., 2016a). However, KM faces several challenges in the business field due to the absence of roadmaps that guide the implementation and consolidation of KM practices in a systemic and gradual way, which has led in many cases to a partial dismantling of this strategy in companies (Pee & Kankanhalli, 2009; Arias-Pérez et al., 2016).

Several attempts to regulate a common model have been done, but management maturity model (KMM) still a concept that requires a consolidated framework (Abu Naser et al., 2016a). Existing KM models are developed based on different theories and methods and they vary greatly in terms of focus and scope (Pee & Kankanhalli, 2009). In order to overcome this problem, some authors have highlighted the lack of a consolidated knowledge management maturity model (KMMM) (Feng, 2005; Lin, 2011).

The first step to building a KMMM is identify factors required for develop KM, so that later the behavior of these factors in each stage may be understood. However, some authors have selected these factors devoid of scientific basis or justification whereas others

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Received Mar. 21, 2017 - Accepted Feb. 22, 2018

Financial support: CAPES and CNPq.

have excluded some key factors to the development of KM because they were considered too complex or difficult to measure. These facts render models incomplete and point to the need for systematic selecting factors that should make up a KMMM based on scientifically accepted criteria (Teah et al., 2006; Pee & Kankanhalli, 2009; Lin, 2011).

Based on the organizational life cycle (OLC) theory, this paper reviews, compares and integrates existing KMMM to propose a complete one that overcome the identified gaps. Consequently, the main purpose of this study is to conduct a systematic review of KMMM, indicating their shortcomings and identifying critical factors for develop a model capable of overcoming these gaps in the future. Identifying shortcomings and factors that should constitute a preliminary KMMM is the first step to creating an integrated model. In this sense, this paper is part of a larger study aiming to conduct an empirical research to validate the combined occurrence of KM factors on stages.

2 Theoretical review

Maturity is the process of development of an object, process, technology or organization over the time (Klimko, 2001; Jiuling et al., 2012; Serenko et al., 2015). In concern to organizations, the maturity models (MM) systematically categorize patterns, named stages, which guide the manager actions (Churchill & Lewis, 1983; Gaál et al., 2008).

For KM, maturity is the effectiveness in manages the knowledge assets on organizations (Sajeva & Jucevicius, 2010). It is the continuous manage of knowledge assets through stages until it is explicitly and systematically defined, managed, controlled and providing effective results for the organization (Kulkarni & Louis, 2003; Teah et al., 2006; Pee & Kankanhalli, 2009). It describes the stages of growth of KM initiatives in an organization (Pee & Kankanhalli, 2009).

KMMM describes the steps of growth and support managers and organizations in order to evaluate the progress of KM practices, guiding the decision-making and indicating performance improvements (Teah et al., 2006; Lin, 2007; Gaál et al., 2008; Oliveira et al., 2010; Lin, 2011; Abu Naser et al., 2016a).

The literature review showed that KMMM are influenced by two approaches: Capability Maturity Model (CMMM) or OLC (Lee & Kim, 2001; Kruger & Johnson, 2010). The first one is based on maturity process of products, like software, and usually come up with predominance of a technical approach. The second one is based on the process of maturity of organizations and come up with predominance of a managerial perspective (Klimko, 2001; Gaál et al., 2008).

The theory about KMM is new, the first paper is from 2001, and there are few studies about the field; most paper just discuss something about KMM; some studies diagnoses some organizations; few studies propose a KMMM and there is not a consolidate model like other areas do (quality management, logistic, knowledge management, knowledge creation and others). Despite some KM models have been proposed in order to guide the progress of KM initiatives in organizations, the literature lacks a consistent approach that has been empirically tested (Pee & Kankanhalli, 2009).

3 Research methods

This is a theoretical study based on a systematic literature review oriented by Hart (1998), Bell (2008) and Martins & Theóphilo (2009) about two types of search: the state of the art provide the identification of recent themes and gaps to explore and; the theoretical search to provide the definition of the constructs based on consolidated researches, which has recognized quality.

A search of "knowledge management" restrict to the last five years at Web of Science resulted in 2.386 papers, which just 361 (about 15%) had at least one citation and 70 (less than 3%) had ten or more citation. The most cited paper was cited for 58 papers. In a search of "knowledge management" without data restriction at the same database, the most cited paper was cited over 1.223 times. This brings out that most of consolidated studies are not addressed by the state of the art search. Thus, the theoretical search oriented this research in order to develop its definition based on studies that has quality and influence know by the academic community.

The systematic literature review carried out in this study was based on the main points raised by Rosim (2014). It was done in three databases most used by researchers, namely, Web of Science, Scopus, and Google Scholar, according to the following steps:

- Analysis of classic papers: meetings with researchers and research groups from fields relevant to the research theme enabled the first contact with classic papers about each topic (KM, OLC and MM);
- Identification of primary keywords: early reading of titles, abstracts, and keywords of these papers enabled preliminary definition of keywords. Key terms (referring to research theme, e.g., *knowledge management*) and limiting terms (which restrict the search to studies of organizations, e.g., *organization* and *organizational*) were then selected;

- Scope and combination of terms: all variations of each keyword and all possible combinations between them were included (in addition to required logical operators);
- Testing of keywords: each combination was tested by means of an exploratory search. For example, there was found a paper that bore a combination of two key terms and no limiting term, which pointed to the need to rethink the search strings;
- Search improvement: this step showed that searches resulted in some papers about the subject, but not the theme, e.g., "product life cycle" but not "organizational life cycle," which required that some search words be excluded through use of the logical operator NOT. Also, in an attempt to narrow the search for themes (*maturity*, *stages*, *life cycle of organizations*, etc.) to research conducted at organizations and no other objects (e.g., *product* or *animals*), the categories *business* and *management* present in the databases were selected;
- Selection criteria: the criteria used for selecting papers were: number of citations of papers and consistency with the research objective, which was accomplished by reading their abstracts. The search was restricted to papers published from 2000 to present for review of state of the art, but included widely cited classic studies, essential to defining the research constructs, regardless of their publishing date.

These steps were followed in an effort to ensure inclusion of papers most relevant to the research problem.

4 Results and discussion

The systematic review of the literature enabled to:

- Identify gaps on KMMM literature;
- Analyze KMMM, which led to the description of its contributions and limitations, and;
- Identify systematically the factors that should make up an integrated KMMM, which will be further tested by empirical research in order to validate the proposal, considering the main gap identified - each model uses different factors (sometimes without any criteria or justification or excluding some critical factor for KM).

4.1 Identification of gaps in knowledge management maturity models

Existing proposals are based on partial reviews and, thus, display several shortcomings:

1. The KMMM based on CMM presuppose the organization as an information-processing machine, disregarding specificities related to people, knowledge, and learning. These proposals expend too much effort on solving technology-related problems and do not pay enough heed to organizational culture, a key factor to KM (Lee & Kim, 2001; Kruger & Snyman, 2005). In addition, software engineering is composed of very structured processes, defined and distinct process areas, and identifiable outcomes. On the other hand, KM practices are not standardized; KM outcomes are not easily measurable, and its activities are scattered throughout the organization amid a large number of knowledge workers (Berztiss, 2002; Kulkarni & Louis, 2003). KMM must be measured from multiple perspectives in order to achieve a holistic assessment of KM development. Consequently, KMMMs have critical areas that are somewhat different from CMMs (Kulkarni & Freeze, 2004). Therefore, CMM-based KMMM display limited vision by treating the organization as a product, disregarding the fact that it is a social construct composed of living organisms that have intentions and desires and is built on power relations. The challenge of managing organizational knowledge has more to do with the interrelation of content, context and people than with technology. Machinery, equipment and buildings are not the most important organizational assets (Akhavan & Jafari, 2006). Approximately 20% of KM is supported by technology other 80% are supported by people and culture (Ruggles, 1998; De Long & Fahey, 2000). Hence, it becomes clear that the technological focus alone does not suffice (Ruggles, 1998);

2. Models influenced by the LCO have a linear, sequential, deterministic, and invariant developmental character. Despite being capable of satisfactorily defining some processes such as product development, these assumptions have been criticized for equating organizations to social organisms (Lee & Kim, 2001; Phelps et al., 2007). Organizational theories inspired by

biological analogies, though providing valuable information on the nature of the organization, are too "crude" to capture the intricacies of internal organization and its connection to KM (Hedlund, 1994). These models do not consider KM specificities (Hedlund, 1994) and that each organization particularly tracks a special sequence of maturity (Abu Naser et al., 2016a). Furthermore, some authors (Miller & Friesen, 1984; Lee & Kim, 2001; Phelps et al., 2007; Gaál et al., 2008) agree about the difficult in proving the sequentially of stages;

3. Approaches influenced by the seminal work of Greiner (1998) present theories geared to permanent growth. However, not all organizations share an interest in unrestricted growth. Some authors argue that the size of organizations has been defined too broadly to shed light on its relationship to organizational structure (Kimberly, 1976; Galbraith, 1982; Churchill & Lewis, 1983; Oliveira & Escrivão, 2011). This view also implies that new or small organizations are "stuck" at the first stage, meaning that, due to their small size, they would never be capable of reaching certain maturity levels (Oliveira & Escrivão, 2011);

4. These models only acknowledge maturity at the final developmental stage, a likely characteristic of the development of a software program or a product (e.g., a car), but probably not of an organization and its management practices, since organizations of different natures may require different KM levels to meet their goals, especially in view of the trade-off between costs and benefits. Not all organizations aspire to reach the topmost KMM level. More often than not, costs outweigh the benefits of reaching the highest KMM level; sometimes it is more advantageous to reach an intermediate level (Kulkarni & Louis, 2003);

5. The small volume of studies and empirical research indicates that the area has not been widely explored. Existing KMMMs have been criticized because most of them have not been validated (Kulkarni & Louis, 2003; Kruger & Snyman, 2005; Pee & Kankanhalli, 2009).

6. Lastly, existing KMMM have been developed based on different theories and methods; they also differ greatly as regards focus and scope. Each model postulates different sets of features, which suggests that these factors have not been well identified nor thoroughly understood up till now. This fact makes the comparison, evaluation, and application of these models very difficult. It is therefore necessary to review, compare, and integrate existing KMMMs in order to identify key elements to KM development (Teah et al., 2006; Pee & Kankanhalli, 2009; Lin, 2011).

According to the identified gaps, future researches could consider the following synthetized recommendations:

a) Consider the specificities of KM as a process (not a product) and companies as social organization and power relations when analyze KMMM influenced by CMM, focusing on culture and people necessities beyond technology aspects;

b) It is necessary to investigate if all different types of organizations develop the KM stages exactly the same way. KMMM does have a liner, sequential, deterministic, invariant and oriented by growth in size behavior? Could an organization skip a stage? Could an organization integrate the external network on KM practices before institutionalize KM on organizational culture? Could an organization an organization aspires just institutionalize their KM practices and not achieve the last stage? Could a small, a medium and a large corporation achieve the same stage of KM, because stages are related to KM practice, not to the size of the organization?;

c) It is important to develop empirical studies and test the theoretical KMMM in order to explore these gaps;

d) Finally and most important, as the literature evidence no consensus about the set of factors that should constitute a KMMM, it is necessary identify these factors from systematic analyze, scientifically criteria and empirical research.

4.2 Analysis of knowledge management maturity models

All KMMM are made up of stages and analysis indicates that different authors describe the stages similarly, with little variation among them. Their descriptions of KMM stages are very similar, varying little from one author to another. Despite some variation, KM is primarily characterized by obliviousness on the part of organizations about the importance of its practices. With increasing organizational awareness of the need for KM comes the planning

or implementation of practices, which in most cases are concerned with supporting technologies and activities aimed at knowledge apprehension, storage, and dissemination. Later, their concern extends to the creation of new knowledge. As time goes by KM practices are formalized and, then, integrated throughout the organization. Finally, KM practices become part of the external network of organizations and are monitored and assessed in order to promote continuous improvement. Table 1 synthetizes the KM stages for this research.

Table 2 provides a summary of studies on the subject. These studies contribute to debates about KMM, but their proposed models still bear limitations. Some authors in Table 2, e.g., Klimko (2001), Berztiss (2002), Aggestam (2006) and Phelps et al. (2007), only describe KM stages based on a review of a few KMMM, thereby not contributing much to the theme. Other studies, e.g., Feng (2005, 2006), Isaai & Amin-Moghadan (2006), Teah et al. (2006), Pee & Kankanhalli (2009), Kruger & Johnson (2010), Gaál et al. (2008) and Oliveira et al. (2010), are limited to diagnosing one or more organizations with the sole purpose of identifying the stage they are at.

Studies that attempt to test the model, e.g., Kulkarni & Louis (2003), Hsieh et al. (2004), Lee & Kim (2005), and Lin (2007, 2011), present a partial selection of components. Thus, they do not conduct an extensive selection based on sources widely cited in the literature on KM; besides, they do not justify the selection made. There are authors, e.g., Hsieh et al. (2004), Lee & Kim (2005), Lin (2011), and Rasula et al. (2008), who leave some components out either to reduce the number of variables or because they are considered too complex or difficult to measure, which renders their analysis incomplete.

Although there are many repeated elements in the different models, each author makes a different selection. Sometimes they disregard some factors that other authors consider essential to the development of KM. Hence, in spite of some factors being cited by several authors, there is no consensus about them.

Thus, they lack a systematic selection of factors that should make up a KMMM, as well as empirical validation that corroborate these components by means of integrated analysis of KMM at organizations (Lee et al., 2001; Teah et al., 2006; Pee & Kankanhalli, 2009; Lin, 2011).

4.3 Identification of factors that should make up the knowledge management maturity model

As the review shows, there is no consensus yet on the factors that should constitute a KMMM. It clearly indicates that every study selects a different set of factors. Furthermore, no author has selected factors in a systematic way according to scientific criteria. Nor have the authors justified or tested these factors through empirical research. Thus, the literature lacks a unified theoretical research model to guide empirical research (Lin, 2011).

This study has identified the factors most cited as essential to KM. Unlike previous studies; none of the factors identified in this study was left out because it was considered too complex or difficult to measure. All factors cited in KMMM (as shown in Table 3) and critical success factors most frequently cited by KM literature (as shown in Table 4) were systematically counted up. Table 3 and 4 show the identified factor, the number of times each factor was cited in the literature and the authors that mentioned this factor.

It can be noted that despite KMMM having different selections of factors and often failing to include some factor widely cited in KM literature (e.g., *culture*, which is not present in 7 of the 21 studies shown in Table 2), the factors cited by these models are basically critical success factors (CSF) previously established in KM literature. However, no model contains all the factors widely cited by KM literature, thereby rendering these models partial and incomplete.

Comparing Table 3 to Table 4 (number of factors cited by KMMM and in the KM literature, respectively) led to the final identification of factors cited as essential to the development of KMM (shown in Table 5) and that should compose a KMMM.

The systematic search and the literature review enabled to develop a summary of all information regarding characteristics of stages and factors that should make up an integrated KMMM. Investigating

Table 1. Stages of KM.

STAGE 1 Functional Initiation	STAGE 2 Functional Specialization	STAGE 3 Internal Integration	STAGE 4 External Integration
Consciousness	**Formalization**	**Institutionalization**	**External network**
- Isolated use of tools in order to manage organizational knowledge.	- Development of infrastructure necessary to KM practice (systems, support, technology) - Strategy and planning of KM	- KM embedded on organizational culture - Control, monitoring, measuring and continuous improvement of KM practices	- KM practices integration to the external network - Partnership

Table 2. Description of the researches on KM.

AUTHOR/STUDY	DESCRIPTION OF THE RESEARCH	STAGES OF THE MODEL	FACTORS OF THE MODEL	CONTRIBUTIONS	LIMITATIONS
Klimko (2001) **KM and MM: building common understanding.**	-Describes stages based on theoretical review.	-Unconsciousness -Technology -Creation -Institutionalization -Partnership		-Describe stages.	-Limited to theoretical review. -Based on two-business model only.
Lee & Kim (2001) **A stage model of organizational KM: a latent content analysis.** Lee et al. (2001) **Stage Model for KM.** Lee & Kim (2005) **Validation of the KM stage model: a triangulation approach**.	-Defines KMM factors through literature review and tests the model by means of case studies.	-Planning -Systems -Monitoring -Networking	-Organizational knowledge -Knowledge workers -Process of KM -Technology	-Confirms the existence of four stages. -Does not confirm temporal progression of stages. -Creates a list of management actions for each stage. -Author tests factors.	-Excludes factors considered too complex to measure (e.g., incentive).
Berztiss (2002) **Capability Maturity for KM.**	-Suggests key process areas based on review of CMM theory (unlike other studies, this one identifies different factors at each stage, others identify the same set of factors present at all stages, despite having different emphasis on each stage).	-Gathering -Representation -External knowledge -Cost benefit	-Knowledge requirements management -Internal knowledge acquisition -Uncertainty awareness -Training -Knowledge representation -Knowledge engineering techniques -User access and profiling -Integrated KMKE process -External knowledge Acquisition -Qualitative cost/benefit analysis -Technical change management -Qualitative cost/benefit analysis	-Suggests key process areas for KMM.	-Limited to theoretical review. -Does not include factors widely cited on the literature (e.g., incentive).
Kulkarni & Louis (2003) **Organizational self-assessment of KMM.**	-Identifies key areas and goals for each stage by means of a pilot and identifies goals and practices specific to each key area by means of a survey.	-Assets identification -Consciousness and culture -Systems and activities -Tools and training -Actualization	-Lessons learned -Knowledge documents -Data -Expertise	-Suggests key areas, goals and practices for KMM.	-Sample is not representative. -Does not include factors widely cited on the literature.

Table 2. Continued...

AUTHOR/STUDY	DESCRIPTION OF THE RESEARCH	STAGES OF THE MODEL	FACTORS OF THE MODEL	CONTRIBUTIONS	LIMITATIONS
Hsieh et al. (2004) **On Constructing a KMMM.**	-Analyzes KM factors through case study.	-Unconsciousness -Technology and structure -Formalization and integration -Control and measurement	-Acquisition -Conversion -Protection -Application -Structure -Technology -Culture	-Suggests factors for KMM.	-Does not include factors widely cited on the literature.
Feng (2005) **Constructing a KMMM from perspective of KM.** Feng (2006) **A KMMM and application.**	-Defines enablers and processes based on theoretical review and diagnoses an organization by means of a case study.	-Planning -Formalization -Control and evaluation -Continuous improvement -Improvement continuous	-Creation -Storage -Dissemination -Application	-Suggests factors for KMM.	-Does not include factors widely cited on the literature. -Limited to diagnosis of one organization.
Aggestam (2006) **Towards a MM for learning organizations: the role of KM.**	-Defines factors based on experience at an organization.	-Begin -KM -Organizational learning -Learning organization	-Culture -Leadership -Vision -Organizational Learning -Process and activities -Internal components (technology etc) -External components (competitors etc) -Organizational memory	-Suggests factors for KMM.	-Based only on professional experience. -Limited to theoretical review.
Isaai & Amin-Moghadan (2006) **A framework to assessment and promotion of KMMM enterprise: modeling and case study.**	-Develops a model based on theoretical review and diagnoses an organization (differs from most models; it does not require an order).	-Consciousness -Strategy -Initiatives -Support -Institutionalization	-Leadership -Structure and Culture -Business process -Tacit knowledge -Explicit knowledge -Knowledge hubs -Market power -Measurement and tools -People and skills -Technology infrastructure	-Suggests key-processes for KMM.	-Limited to diagnose of one organization.

Table 2. Continued...

AUTHOR/STUDY	DESCRIPTION OF THE RESEARCH	STAGES OF THE MODEL	FACTORS OF THE MODEL	CONTRIBUTIONS	LIMITATIONS
Teah et al. (2006) **Development and application of a general KMMM.** Pee & Kankanhalli (2009) **A model of knowledge organizational management maturity: based on people, process and technology.**	-Develops a model based on theoretical review. -Diagnoses departments of an organization by means of interviews.	-Unconsciousness -Consciousness -Infrastructure -Initiatives -Integration	-People -Process -Technology	-Proposes that areas of key processes of an organization can be at different stages (one factor may be more developed than another).	- Limited to diagnose of organizations.
Phelps et al. (2007) **Life cycles of growing organizations: a review with implications for knowledge and learning**.	-Identifies KM problems (organizations need to solve these problems in order to reach maturity).	-Unconsciousness -Consciousness -New knowledge -Implementation	-People management -Obtaining financing -Formal systems -Strategy -Market entry	-Identifies problems that hinder KMM.	-Exclude non-measurable factors. -Does not include factors widely cited on the literature. -Limited to theoretical review.
Kruger & Snyman (2007) **Guideline for assessing the KMM of organizations.** Kruger & Johnson (2010) **Principles in KMM: a South African perspective.**	-Devises a questionnaire to investigate KMM based on theoretical review and on a questionnaire developed by OCDE's Public Administration Service, test the questionnaire and diagnoses companies.	-TIC -Formalization -Consciousness -Strategic management -Applying		-Tests a questionnaire for investigation of KMM. -Confirms importance of some factors to KMM.	-Limited to diagnose of organizations.
Lin (2007) **A stage model of KM: an empirical investigation of process and effectiveness.** Lin (2011) **Antecedents of the stage-based KM evolution.**	-Proposes factors to develop KMM and conducts a pretest and a survey at an organization in order to confirm them and checks their impact at each KMM stage.	-Plan -Infrastructure -Network	-Knowledge acquisition -Knowledge conversion -Knowledge application -Knowledge protection -Individual level-effectiveness -Organizational level-effectiveness -Organizational support -IT diffusion	-Confirms KMM factors. -Checks relationship between factors and each stage.	-Does not include factors widely cited on the literature. -Does not analyze all factors together.

Table 2. Continued...

AUTHOR/STUDY	DESCRIPTION OF THE RESEARCH	STAGES OF THE MODEL	FACTORS OF THE MODEL	CONTRIBUTIONS	LIMITATIONS
Rasula et al. (2008) **The integrated KMMM.**	-Identifies factors in the theory, disregards those which cannot be measured or do not fit in any of the three main created categories and tests them by means of empirical research.	-Few activities -Resources -Structure -Improvement and measurement	-Knowledge accumulation -Knowledge acquisition -Knowledge sharing -Ownership of knowledge -Strategy, plans and KM systems -Organizational learning -Environment -People and organizational climate -Process -Capturing knowledge -Information technology tools	-Identifies KMM factors.	-Excludes non-measurable factors.
Gaál et al. (2008) **KM profile MM.**	-Defines KM factors based on theoretical review and employ a survey conducted in conjunction with KPMG to diagnoses a group of companies.	-Consciousness -Inventory -Sharing -Technology -Information -Network -Infrastructure		-Identifies KMM factors.	-Does not include factors widely cited on the literature. -Limited to diagnose of organizations.
Grundstein (2008) **Assessing the enterprise's KMM level.**	-Defines KM factors and creates a description of stages from the analysis of an IT good practices guide.	-Unconsciousness -Consciousness -Intuitive -Formalization -Control and measure -Best practices	-Sociotechnical environment -Value adding-process -Managerial guide principals -Ad hoc infrastructure -KM generic processes -Learning processes -Methods and supporting tools	-Identifies KM factor.	-Based on IT specificities.

Table 2. Continued...

AUTHOR/STUDY	DESCRIPTION OF THE RESEARCH	STAGES OF THE MODEL	FACTORS OF THE MODEL	CONTRIBUTIONS	LIMITATIONS
Oliveira et al. (2010) **KM implementation in stages: the case of organizations in Brazil.**	-Analyzes KMMM from the literature, defines factors cited in them, and summarizes and combines two KMM in order to diagnoses two organizations.		-Technology -Culture -Support of top management -Team and leadership -Tacit and explicit knowledge -Alignment between KM and business goals -KM goals -Rewards systems -External environment -Training -Financing -Communication -Critical knowledge	-Identifies KMM factors.	-Limited to the diagnosis of two organizations.
Oliva (2014)	-Identifies barriers and practices associated with KM.	-Insufficient -Structured -Oriented -Integrative	-Organization -Information -Culture -Participation -Engagement	-Creates a KMMM based on barriers and practices identified.	-Not empirically validated.
Serna (2015) **MM of transdisciplinary KM.**	-Proposes a transdisciplinary KMM by means of theoretical review. -Is oriented to strengthen the social benefits of transdisciplinary research.	-Predisposed -Reaction -Evaluation -Organized -Optimized		-Brings an original propose to KMMM.	-Not empirically validated.
Abu Naser et al. (2016a) **KMM in universities and its impact on performance excellence.** Abu Naser et al. (2016b) **Measuring KMM at HEI to enhance performance-an empirical study at Al-Azhar University in Palestine.**	-Uses KMM to measure performance in two universities.	-Reaction -Initiation level -Expansion -Refinement -Maturity	-Leadership -Process -People -Technology -Knowledge process -Learning and innovation -KM outcomes	-Identifies the most important factors affecting performance excellence.	-Does not include factors widely cited on the literature.

Table 2. Continued...

AUTHOR/STUDY	DESCRIPTION OF THE RESEARCH	STAGES OF THE MODEL	FACTORS OF THE MODEL	CONTRIBUTIONS	LIMITATIONS
Arias-Pérez et al. (2016) **Building a KMMM for a multinational food company from an emerging economy.**	-Proposes a KMMM by means of theoretical review and diagnosed an organization through survey and interviews.	-Initial -Exploratory -Used -Managed -Innovation	-Process -Technology -Strategy -Culture	-Theoretical review includes several KMMM.	-Limited to diagnose of organization.
Fashami & Babaei (2017) **A Behavioral MM to establish KM in an organization.**	-Identifies factors on behavioral maturity of managers in establishing KM through theoretical review, interviews with experts, and comparison of variables by academic and experts.		-Personnel empowerment -Training courses -Teamwork spirit -Decision-making power -Human and social skill -Trustful climate -Commitment and responsibility -Knowledge orientation -Quantitative management -Supportive behavior -Transformational leadership -Emotional intelligence -Stimulation and motivation	-Identify KMM factors.	-Does not include factors widely cited on the literature (e.g. culture).

Table 3. Factors of KMMMs.

FACTOR	Nº	AUTHORS
Process (acquisition, storage, conversion, creation, dissemination, application)	18	Lee et al. (2001), Lee & Kim (2001, 2005), Berztiss (2002), Feng (2005, 2006), Teah et al. (2006), Aggestam (2006), Kruger & Johnson (2010), Kruger & Snyman (2007), Lin (2007), Rasula et al. (2008), Grundstein (2008), Gaál et al. (2008), Pee & Kankanhalli (2009), Lin (2011), Abu Naser et al. (2016a), Arias-Pérez et al. (2016)
Technology (environment)	17	Lee et al. (2001), Lee & Kim (2001, 2005), Feng (2005, 2006), Aggestam (2006), Isaai & Amin-Moghadan (2006), Teah et al. (2006), Rasula et al. (2008), Gaál et al. (2008), Grundstein (2008), Kruger & Johnson (2010), Kruger & Snyman (2007), Pee & Kankanhalli (2009), Oliveira et al. (2010), Abu Naser et al. (2016a), Arias-Pérez et al. (2016)
Culture	14	Feng (2005, 2006), Aggestam (2006), Isaai & Amin-Moghadan (2006), Kruger & Johnson (2010), Kruger & Snyman (2007), Lin (2007), Phelps et al. (2007), Grundstein (2008), Rasula et al. (2008), Oliveira et al. (2010), Lin (2011), Oliva (2014), Arias-Pérez et al. (2016)
Support of top management (leadership, team, knowledge work)	13	Lee et al. (2001), Lee & Kim (2001, 2005), Isaai & Amin-Moghadan (2006), Teah et al. (2006), Aggestam (2006), Isaai & Amin-Moghadan (2006), Lin (2007), Pee & Kankanhalli (2009), Oliveira et al. (2010), Lin (2011), Abu Naser et al. (2016a), Fashami & Babaei (2017)
Infrastructure	8	Feng (2005, 2006), Isaai & Amin-Moghadan (2006), Lin (2007), Gaál et al. (2008), Grundstein (2008), Lin (2011), Oliveira et al. (2010)
Human resources management (benefits, rewards, training)	8	Berztiss (2002), Lin (2007), Phelps et al. (2007), Rasula et al. (2008), Oliveira et al. (2010), Lin (2011), Oliva (2014), Fashami & Babaei (2017)
Organizational knowledge	6	Lee et al. (2001), Lee & Kim (2001, 2005), Isaai & Amin-Moghadan (2006), Phelps et al. (2007), Oliveira et al. (2010)
Learning	6	Kulkarni & Louis (2003), Aggestam (2006), Rasula et al. (2008), Grundstein (2008), Oliveira et al. (2010), Abu Naser et al. (2016a)
Strategy	5	Phelps et al. (2007), Kruger & Johnson (2010), Kruger & Snyman (2007), Rasula et al. (2008), Arias-Pérez et al. (2016)
Measuring	3	Isaai & Amin-Moghadan (2006), Kruger & Johnson (2010), Kruger & Snyman (2007)

Table 4. Critical success factors of KM literature.

FACTOR	Nº	AUTHORS
Culture	12	Skyrme & Amidon (1997), Davenport et al. (1998), Fahey & Prusak (1998), Leibowitz (1999), Holsapple & Joshi (2000), Hasanali (2002), Alazmi & Zairi (2003), Dana et al. (2005), Al-Mabrouk (2006), Ajmal et al. (2009), Conley & Wei Zheng (2009), Lehner & Haas (2010)
Support of top management (motivation, leadership, coordination)	11	Ruggles (1998), Skyrme & Amidon (1997), Davenport et al. (1998), Leibowitz (1999), Holsapple & Joshi (2000), Hasanali (2002), Alazmi & Zairi (2003), Al-Mabrouk (2006), Ajmal et al. (2009), Lehner & Haas (2010), Conley & Wei Zheng (2009)
Infrastructure **Systems** **Tools**	9	Davenport et al. (1998), Leibowitz (1999), Holsapple & Joshi (2000), Hasanali (2002), Alazmi & Zairi (2003), Dana et al. (2005), Al-Mabrouk (2006), Ajmal et al. (2009), Conley & Wei Zheng (2009)
Humana resource management (education, training, motivation, incentive)	8	Davenport et al. (1998), Leibowitz (1999), Holsapple & Joshi (2000), Chourides et al. (2003), Al-Mabrouk (2006), Ajmal et al. (2009), Conley & Wei Zheng (2009), Lehner & Haas (2010)
Technology	8	Skyrme & Amidon (1997), Davenport et al. (1998), Leibowitz (1999), Hasanali (2002), Chourides et al. (2003), Al-Mabrouk (2006), Conley & Wei Zheng (2009), Lehner & Haas (2010)
Strategy	5	Leibowitz (1999), Holsapple & Joshi (2000), Chourides et al. (2003), Al-Mabrouk (2006), Conley & Wei Zheng (2009)
Measuring	4	Holsapple & Joshi (2000), Hasanali (2002), Al-Mabrouk (2006), Conley & Wei Zheng (2009)

Table 5. Critical success factor of KMM.

CRITICAL SUCCESS FACTOR	DEFINITION
Organizational infrastructure	-Type of structure -Team format -Formalization degree of process and activities -Process of communication -Environment
Technology	-Databases -Electronic document management -Programs, software and interactive platforms
Culture	-Collaboration -Confidence -Learning
Human resources management	-Training (coaching, mentoring) -Rewards -Opportunities to participate
Support of top management	-Incentive (motivation) -Leadership

these systematically and conceptually defined variables by means of empirical research can confirm or corroborate these findings and identify relationships between them.

Once shortcomings to be overcome in KMMM are cataloged, stages described, and factors that should make up the model are identified, the next step, which has already been taken by the authors of this paper, is to conduct a thorough and rigorous investigation so as to confirm its validity and explore these factors at every stage. As this paper is part of a larger research, all complementary information - like definitions of concepts - can be found at Escrivão (2015).

5 Conclusion

This study provides a systematic review, an identification of main gaps and a comparison of existing KMMMs, which can potentially support the development of a complete and integrated KMMM.

This research showed that there are several criticisms of KMMM to be addressed and some shortcomings to be overcome. Despite their contributions, most studies in the field are limited to reaching a diagnosis for an organization. The analysis of the models revealed that this theme is recent and there are few empirical studies that seek to understand KMM at organizations. In cases where there is an attempt to validate the model through empirical research, problems regarding research quality and reliability arise (e.g., by failing to consider factors widely cited in the literature or when researchers leave factors out of the analysis without scientific justification).

Therefore, there was a lack of studies with a robust academic basis capable of identifying essential factors to MKM through extensive literature review; a review that excludes no factors cited in the literature, in search of an integrated model, and investigates every single factor so as to build a reliable model in accordance with scientific research criteria.

Thus, this paper has contributed the following:

- A review and analysis of existing KMMM has been carried out to bring forth their contributions and drawbacks;
- The main criticisms and shortcomings found in KMMM have been identified so as to guide the construction of a model to address those gaps;
- Finally, factors relevant to the development of MKM have been identified, systematic and conceptually, which must be confirmed and whose behavior must be explored through empirical research.

This study is part of a larger ongoing research project, which has already started a survey in order to confirm these factors. Subsequently, case studies aimed at investigating and understanding how each factor behaves at each stage will be conducted, thereby informing the construction of a KMMM validated by empirical evidence.

Acknowledgements

National Council for Scientific and Technological Development (CNPq), Brazil.

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