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...
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;
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; Krugher & Snyman, 2005; Pee & Kankanhalli, 2009).

6. Lastly, existing KMM 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 synthesized 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. KMMMs do 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 KMM 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 KMM, it is necessary identify these factors from systematic analyze, scientifically criteria and empirical research.

4.2 Analysis of knowledge management maturity models

All KMM 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 synthesizes the KM stages for this research.

Table 2 provides a summary of studies on the subject. These studies contribute to debates about KMMM, but their proposed models still bear limitations. Some authors in Table 2, e.g., Klimko (2001), Berztiss (2002), Amin-Moghadan (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), Lee & 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), 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), and 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 KMMM 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 KMMM (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) | - KM embedded on organizational culture | - KM practices integration to the external network |
| | - Strategy and planning of KM | - Control, monitoring, measuring and continuous improvement of KM practices | - Partnership |
| 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 | -Describe stages. | -Limited to theoretical review. |
| Lee & Kim (2001) | A stage model of organizational KM: a latent content analysis. | -Defines KMM factors through literature review and tests the model by means of case studies. | -Planning | -Confirms the existence of four stages. | -Excludes factors considered too complex to measure (e.g., incentive). |
| Lee et al. (2001) | Stage Model for KM. | -Unconsciousness | -Technology | | |
| Lee & Kim (2005) | Validation of the KM stage model: a triangulation approach. | -Unconsciousness | -Technology | | |
| 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 | -Suggests key process areas for KMM. | -Limited to theoretical review. |
| Kulkami & 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 | -Suggests key areas, goals and practices for KMM. | -Sample is not representative. |
| | | -Consciousness and culture | -Knowledge documents | | -Does not include factors widely cited on the literature. |
| 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 | -Acquisition | Suggests factors for KMM. | Does not include factors widely cited on the literature. |
| | | Technology and structure | -Conversion | | |
| | | Formalization and integration | -Protection | | |
| | | Control and measurement | -Application | | |
| | | | -Structure | | |
| | | | -Technology | | |
| | | | -Culture | | |
| Feng (2005) Constructing a KMMM from perspective of KM. | Defines enablers and processes based on theoretical review and diagnoses an organization by means of a case study. | Planning | -Creation | Suggests factors for KMM. | Does not include factors widely cited on the literature. |
| Feng (2006) A KMMM and application. | Defines factors based on experience at an organization. | Formalization | -Storage | | Limited to diagnosis of one organization. |
| | | Control and evaluation | -Dissemination | | |
| | | Continuous improvement | -Application | | |
| | | Improvement continuous | | | |
| Aggestam (2006) Towards a MM for learning organizations: the role of KM. | Develops a model based on theoretical review and diagnoses an organization (differs from most models; it does not require an order). | Begin | -Culture | Suggests factors for KMM. | Based only on professional experience. |
| | | KM | -Leadership | | Limited to theoretical review. |
| | | Organizational learning | -Vision | | |
| | | Learning organization | -Organizational Learning | | |
| | | | -Process and activities | | |
| | | | -Internal components (technology etc) | | |
| | | | -External components (competitors etc) | | |
| | | | -Organizational memory | | |
| 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 | -Leadership | Suggest key-processes for KMM. | Limited to diagnose of one organization. |
| | | Strategy | -Structure and Culture | | |
| | | Initiatives | -Business process | | |
| | | Support | -Tacit knowledge | | |
| | | Institutionalization | -Explicit knowledge | | |
| | | | -Knowledge hubs | | |
| | | | -Market power | | |
| | | | -Measurement and tools | | |
| | | | -People and skills | | |
| | | | -Technology infrastructure | | |
| 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. | -Develops a model based on theoretical review. | -Unconsciousness | -People | -Proposes that areas of key processes of an organization can be at different stages (one factor may be more developed than another). |
| | | -Diagnoses departments of an organization by means of interviews. | -Consciousness | -Process | | -Limited to diagnose of organizations. |
| Pee & Kankanhalli (2009) | A model of knowledge organizational management maturity: based on people, process and technology. | | -Infrastructure | -Technology | | |
| 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 | -People management | | |
| | | -TIC | -Consciousness | -Obtaining financing | -Identifies problems that hinder KMM. |
| | | -Implementation | -New knowledge | -Formal systems | | -Exclude non-measurable factors. |
| | | -Integration | -Strategy | -Market entry | | -Does not include factors widely cited on the literature. |
| | | | | | -Limited to theoretical review. |
| Kruger & Snyman (2007) | Guideline for assessing the KMM of organizations. | -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 | -Tests a questionnaire for investigation of KMM. |
| | | -Formalization | -Consciousness | -Confirms importance of some factors to KMM. |
| | | -Strategic management | -Applying | | -Limited to diagnose of organizations. |
| Lin (2007) | A stage model of KM: an empirical investigation of process and effectiveness. | -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 | -Confirms KMM factors. |
| | | -Infrastructure | -Knowledge acquisition | -Checks relationship between factors and each stage. |
| | | -Network | -Knowledge conversion | -Does not include factors widely cited on the literature. |
| Lin (2011) | Antecedents of the stage-based KM evolution. | | -Knowledge application | | -Does not analyze all factors together. |
| | | | -Knowledge protection | | |
| | | | -Individual level-effectiveness | | |
| | | | -Organizational level-effectiveness | | |
| | | | -Organizational support | | |
| | | | -IT diffusion | | |
| 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.** | -Uses KMMM 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. |
| 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). |
| 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), 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) |
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.

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References

Abu Naser, S. S., Al Shobaki, M. J., & Abu Amuna, Y. M. (2016a). Knowledge management maturity in universities and its impact on performance excellence: comparative study. *Journal of Scientific and Engineering Research, 3*, 4-14.
Abu Naser, S. S., Al Shobaki, M. J., & Abu Amuna, Y. M. (2016b). Measuring knowledge management maturity at HEI to enhance performance—an empirical study at Al-Azhar University in Palestine. International Journal of Commerce and Management Research, 2(5), 55-62.

Aggestam, L. (2006). Towards a maturity model for learning organizations: the role of knowledge management. In Proceedings of the International Conference on Database and Expert Systems Applications (pp. 141-145). USA: IEEE Computer Science. http://dx.doi.org/10.1109/DEXA.2006.138.

Ajmal, M., Helo, P., & Kekale, T. (2009). Critical factors for knowledge management in project business. Journal of Knowledge Management, 14(1), 156-178.

Akhavan, P., & Jafari, M. (2006). Re-engineering in organization. Journal of Tabdir, 14(5), 12-23.

Alazmi, M., & Zairi, M. (2003). Knowledge management critical success factors. Total Quality Management, 14(2), 199-204. http://dx.doi.org/10.1080/1478336032000051386.

Al-Mabrouk, K. (2006). Critical success factors affecting knowledge management adoption: a review of the literature. Innovations in Information Technology. USA: IEEE.

Arias-Pérez, J., Tavera-Mesias, J., & Castano-Serna, D. (2016). Building a knowledge management maturity model for a multinational food company from an emerging economy. El Profesional de la Información, 25(1), 88-102.

Bell, J. (2008). Projeto de pesquisa: guia para pesquisadores iniciantes em educação, saúde e ciências sociais. Porto Alegre: Arntmed.

Berztiss, A. T. (2002). Capability maturity for knowledge management. In Proceedings of the International Workshop on Database and Expert Systems Applications (pp. 162-166). USA: IEEE Computer Society. http://dx.doi.org/10.1109/DEXA.2002.1045893.

Chourides, P., Longbottom, D., & Murphy, W. (2003). Excellence in knowledge management: an empirical study to identify critical factors and performance measures. Measuring Business Excellence, 7(2), 29-45. http://dx.doi.org/10.1016/S13683040(03)1047797.

Churchill, N. C., & Lewis, V. L. (1983). The five stages of small business growth. Harvard Business Review, 61, 30-50.

Conley, C. A., & Wei Zheng, (2009). Factors critical to knowledge management success. Advances in Developing Human Resources, 11(3), 334-348. http://dx.doi.org/10.1177/1523422309338159.

Dana, L. P., Korot, L., & Tovstiga, G. (2005). A cross-national comparison of knowledge management practices. International Journal of Manpower, 26(1), 10-22.

Davenport, T., De Long, D., & Beers, M. (1998). Successful knowledge management projects. Sloan Management Review, 39(2), 43-57.

De Long, D. W., & Fahey, L. (2000). Diagnosing cultural barriers to knowledge management. The Academy of Management Executive, 14(4), 113-127.

Escrivão, G. (2015). Fatores críticos de sucesso e estágios da maturidade da gestão do conhecimento: um estudo na Embrapa. (Tese de doutorado). Universidade Federal de São Carlos, São Carlos.

Fahey, L., & Prusak, L. (1998). The eleven dead list sins of knowledge management. California Management Review, 40(3), 2655-276. http://dx.doi.org/10.2307/41165954.

Fashami, C. S., & Babaei, M. (2017). A behavioral maturity model to establish knowledge management in an organization engineering. Technology & Applied Science Research, 7(3), 1725-1731.

Feng, J. (2005). Constructing a knowledge management maturity model from perspective of knowledge management. In Proceedings of the International Engineering Management Conference (pp. 912-917). USA: IEEE.

Feng, J. (2006). A knowledge management maturity model and application. In Proceedings of the Technology Management for the Global Future (pp. 1251-1255). USA: IEEE. http://dx.doi.org/10.1109/PICMET.2006.296693.

Gaál, Z., Szabó, L., Kovács, Z., Obermayer-Kovács, N., & Csepregi, A. (2008). Knowledge management profile maturity model. In Proceedings of the European Conference on Knowledge Management (pp. 209-216). Southampton: ACPI.

Galbraith, J. (1982). The stages of growth. The Journal of Business Strategy, 3(4), 70-79. http://dx.doi.org/10.1108/eb038958.

Greiner, L. E. (1998). Evolution and revolution as organizations grow. Harvard Business Review, 76(3), 55-60, 62-66, 68. PMid:10179654.

Grundstein, M. (2008). Assessing the enterprise’s knowledge management maturity level. International Journal of Knowledge and Learning, 4(5), 415-426. http://dx.doi.org/10.1504/IJKL.2008.022060.

Hart, C. (1998). Doing a literature review: releasing the social science research imagination. London: Sage Publications.

Hasanali, F. (2002). Critical success factors of knowledge management. Retrieved in 2002 May 5, from www.kmadvantage.com/docs/km_articles/Critical_Sucess_Factors_of_KM.pdf

Hedlund, G. (1994). A model of knowledge management and the N-form corporation. Strategic Management Journal, 15(S2), 73-90. http://dx.doi.org/10.1002/smj.4250151006.
Holsapple, C. W., & Joshi, K. D. (2000). An investigation of factors that influence the management of knowledge in organizations. *The Journal of Strategic Information Systems, 9*(2/3), 235-261. http://dx.doi.org/10.1016/S0963-8687(00)00046-9.

Hsieh, Y., Hun, Y., & Chou, S. T. (2004). On constructing a knowledge management maturity model. In *Proceedings of the Workshop on Knowledge Economy and Electronic Commerce* (pp. 289-302). USA: ACM.

Isaai, M. T., & Amin-Moghadan, A. (2006). A framework to assessment and promotion of knowledge management maturity model enterprise: modeling and case study. In *Proceedings of the International Conference on Management of Innovation and Technology* (pp. 163-165). USA: IEEE.

Jiuling, W., Jiankang, W., & Hongjiang, Y. (2012). Study on maturity level transition mechanism of knowledge management. In *Proceedings of the International Conference on Information Systems* (pp. 289-302). USA: ACM.

Kimberly, J. R. (1976). Organizational size and the structuralist perspective: a review, critique and proposal. *Administrative Science Quarterly, 21*(4), 571-597. http://dx.doi.org/10.2307/2391717.

Klimko, G. (2001). Knowledge management and maturity models: building common understanding. In *Proceedings of the European Conference on Knowledge Management* (pp. 269-278). Southampton: ACPI.

Kruger, C. J., & Johnson, R. D. (2010). Principles in knowledge management maturity: a South African perspective. *Journal of Knowledge Management, 14*(4), 540-556. http://dx.doi.org/10.1108/13673271011059518.

Kruger, C. J., & Snyman, M. M. M. (2005). Formulation of a strategic knowledge management maturity model. *South African Journal of Information Management, 7*(2), 1-11. http://dx.doi.org/10.4102/sajim.v7i2.261.

Kruger, C. J., & Snyman, M. M. M. (2007). Guideline for assessing the knowledge management maturity of organizations. *South African Journal of Information, 9*(3), 1-11. http://dx.doi.org/10.4102/sajim.v9i3.34.

Kulkarni, U., & Freeze, R. (2004). Development and validation of a knowledge management capability assessment model. In *Proceedings of the 25th International Conference on Information Systems* (pp. 647-670). Denmark: Interaction Design Foundation.

Kulkarni, U., & Louis, R. S. (2003). Organizational self-assessment of knowledge management maturity. In *Proceedings of the Americas Conference on Information Systems*. USA: AMICS.

Lee, D. Y., & Kim, Y. G. (2005). Validation of the knowledge management stage model: a triangulation approach. In *Proceedings of the Annual Hawaii International Conference on System Sciences*. USA: IEEE.

Lee, J. H., & Kim, Y. G. (2001). A stage model of organizational knowledge management: a latent content analysis. *Expert Systems with Applications, 20*(4), 299-311. http://dx.doi.org/10.1016/S0957-4174(01)00015-X.

Lee, J. H., Kim, Y. G., & Yu, S. (2001). Stage model for knowledge management. In *Proceedings of the Annual Hawaii International Conference on System Sciences* (pp. 1-10). USA: Computer Society Press.

Lehner, F., & Haas, N. (2010). Knowledge management success factors: proposal of an empirical research. *Electronic Journal of Knowledge Management, 8*(1), 79-90.

Leibowitz, J. (1999). Key ingredients to the success of an organization knowledge management strategy. *Knowledge and Process Management, 6*(1), 37-40. http://dx.doi.org/10.1002/(SICI)1099-1441(199903)6:1<37::AID-KPM40>3.0.CO;2-M.

Lin, H. (2011). Antecedents of the stage-based knowledge management evolution. *Journal of Knowledge Management, 15*(1), 136-155. http://dx.doi.org/10.1108/13673271111108747.

Lin, H. F. (2007). A stage model of knowledge management: an empirical investigation of process and effectiveness. *Journal of Information Science, 33*(6), 643-659. http://dx.doi.org/10.1177/01655515060765395.

Martins, G. A., & Theóphilo, C. R. (2009). *Metodologia da investigação científica para ciências sociais aplicadas*. São Paulo: Atlas.

Miller, D., & Friesen, P. (1984). A longitudinal study of the corporate life cycle. *Management Science, 30*(10), 1161-1183. http://dx.doi.org/10.1287/mnsc.30.10.1161.

Oliva, F. L. (2014). Knowledge management barriers, practices and maturity model. *Journal of Knowledge Management, 18*(6), 1053-1074. http://dx.doi.org/10.1108/JKM-03-2014-0080.

Oliveira, J., & Escrivão, E., Fo. (2011). Ciclo de vida organizacional: descrição de três estágios de desenvolvimento das pequenas empresas em quatro especificidades. *Economia Global e Gestão, 16*, 81-102.

Oliveira, M., Pedron, C. D., & Maçada, A. C. G. (2010). Knowledge management implementation in stages: the case of organizations in Brazil. In *Proceedings of the European Conference on Knowledge Management* (pp. 1-8). Southampton: ACPI.

Pee, L. G., & Kankanhalli, A. (2009). A model of knowledge organizational management maturity: based on people, process and technology. *Journal of Information and Knowledge Management, 8*(2), 79-99. http://dx.doi.org/10.1142/S0219649209002270.

Phelps, R., Adams, R., & Bessant, J. (2007). Life cycles of growing organizations: a review with implications for knowledge and learning. *International Journal of Management Reviews, 9*(1), 1-30. http://dx.doi.org/10.1111/j.1468-2370.2007.00200.x.
Rasula, J., Vukšiae, V. B., & Stemberger, M. I. (2008). The integrated knowledge management maturity model. *Zagreb International Review of Economics & Business, 11*(2), 47-62.

Rosim, D. (2014). *Trabalho do dirigente e desempenho da pequena empresa: estudo de casos em empresas do setor metal-mecânico* (Tese de doutorado). Departamento de Engenharia Industrial, Universidade de São Paulo, São Carlos.

Ruggles, R. (1998). The state of the notion: knowledge management in practice. *California Management Review, 40*(3), 80-89. [http://dx.doi.org/10.2307/41165944](http://dx.doi.org/10.2307/41165944).

Sajeva, S., & Jucevičius, R. (2010). The model of knowledge management system maturity and its approbation in business companies. *Ocialiniai Mokslai, 3*(69), 57-68.

Serenko, A., Hull, E., & Bontis, N. (2015). An application of the knowledge management maturity model: the case of credit unions. *Knowledge Management Research and Practice, 13*, 1-15.

Serna, M. E. (2015). Maturity model of transdisciplinary knowledge management. *International Journal of Information Management, 35*(6), 647-654. [http://dx.doi.org/10.1016/j.ijinfomgt.2015.07.002](http://dx.doi.org/10.1016/j.ijinfomgt.2015.07.002).

Skyrme, D., & Amidon, D. (1997). The knowledge agenda. *Journal of Knowledge Management, 1*(1), 27-37. [http://dx.doi.org/10.1108/13673279710800709](http://dx.doi.org/10.1108/13673279710800709).

Teah, H. Y., Pee, L. G., & Kankanhalli, A. (2006). Development and application of a general knowledge management maturity model. In *Proceedings of the Pacific Asia Conference on Information Systems* (pp. 401-416). USA: AIS.