A theoretical and methodological examination of knowledge management maturity models: a systematic review

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Abstract: During two decades ago, researches related to maturity models have grown increasingly. Investigating theoretical basics of maturity models in knowledge management (KM) field and revealing the gaps in this domain are challenging tasks for researchers. Until today, no studies have been available summarising the theoretical foundations, methods and results of KM maturity models. To gain research objective, systematic literature review was conducted in related studies from valid scientific databases during 2000 to 2014. In this study, in addition to addressing KM paradigms generally, theoretical foundations of KM maturity researches have also examined. The results show that functionalist is the prominent paradigm while this paradigm has criticised in many IS researches. Researchers can use the findings as starting point for developing new KM maturity model. The main research contribution is structuring available literature of KM maturity models to identify their theoretical foundations as well as research gaps via a systematic way.

Keywords: knowledge management; maturity models; KM paradigms; mapping study.


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1 Introduction

Knowledge management (KM) is one of the most popular business issues which assist organisation to gain competitive advantage (Jamporazmey and Mehrafrouz, 2012; Chen and Fong, 2015), support organisation’s survival and excellent performance (Sigala and Chalkiti, 2014), improve the efficiency of business processes and increase the productivity and quality of its services (Donate and de Pablo, 2015). By emerging the era of the knowledge economy, domain of KM has received increasing attentions from both academics and practitioners (Lee and Chen, 2012; Massingham, 2014). Database studies imply that the first reference to KM is emerged in 1987 and until now more than 2,500 academic papers has published (Guo and Sheffield, 2008).

Recently, maturity models have received much attention and they are one of the most important topics in information systems (Patas, 2012) and knowledge management. Over the past two decades, the publications related to maturity models and process improvement rose increasingly (Wendler, 2012; Muller and Nielsen, 2013). When talking about maturity models, the first concept that comes to mind is capability maturity model integration (CMMI) (Wendler, 2012). CMMI enables you to assess your organisational maturity and process area capability. It identifies priorities for improvement, and provides guidance on the implementation of these improvements (Dayan and Evans, 2006). Maturity models can be considered as a comprehensive framework for improving and evaluating given capabilities and processes. Generally, these models assist organisations to understand current position systematically and they also identify improvement and implementation priorities (Lee et al., 2010). Fundamentally, maturity models consist of multiple archetypal levels that jointly represent the evolution path of a certain domain (Patas, 2012).

Any research project should be based on philosophical assumptions about world nature and how to gather knowledge about the very essence of the whole world. Researchers’ beliefs and assumptions have affected the research methods significantly (Manian et al., 2014). Often these assumptions have been considered implicit and incontestable. It seems that the paradigms are able to give solidarity to KM domain and distinguish this area from other fields. In fact, The KM literature is still in its theorising stage (Lee and Chen, 2012; Guo and Sheffield, 2008), therefore, KM researchers have to structure themselves researches by investigating research paradigms, principles, key concepts and research methods. Despite numerous research have been done in KM maturity field, few researches has been conducted about KM theoretical foundations and
its philosophical basics. It is must be noted that the variety and volume of KM maturity studies make necessary analysing and structuring this domain of researches by systematic manner.

It is very likely that KM maturity model designers are interested not only in the development of new models for as yet uncovered research areas, but also in the comparison and integration of existing KM maturity models.

As Wendler (2012) claims it is a challenging task to discover the existence of a scientific paradigm and theoretical perspective in maturity model. Most prior studies in KM maturity models primarily focus on development, validation and application of KM maturity model rather than focusing on providing a comprehensive review of theoretical perspective of this domain. According to the researcher’s knowledge, there is no mapping study or systematic review about KM maturity models available. Therefore, this study provides a systematic review to capture and summarise the content of KM maturity model which enhance understanding of KM maturity researches and existing gaps in this field.

The systematic mapping study is appropriate approach to achieve this objective. A mapping study – as a specific form of literature review – aims at reviewing a relatively topic by identifying, analysing, and structuring the goals, methods, and contents of conducted primary studies (Wendler, 2012). Consequently, the research gaps, or current results of this studies can be identified via comprehensive examination.

In sum, the main objective of this study is to provide the first comprehensive summary of existing research publications about KM maturity models.

The remainder of this article is structured as follows. In Section 2, related literatures are discussed. Research method is explained in Section 3. In Section 4, classification schema is discussed. The findings are explained in Section 5. Conclusions are summarised in Section 6. Suggestions for future studies are proposed in Section 7.

2 Literature review

2.1 Knowledge and knowledge management

Serna (2012) stated that the majority definitions of knowledge belong to one of the following groups:

1. knowledge is defined by comparison or relation with data and information
2. it can be defined without any direct link to data and information.

In the first group, knowledge has seen as an entity which is situated in the higher level than data and information. Meanwhile in real world, it is difficult to distinguish among knowledge, information and data, second group of knowledge definitions propose the features of knowledge, quality and components and avoid of comparison between knowledge and management.

There are three perspectives about organisational knowledge which lead to differences in methodological approaches. These include:
The first perspective mentions that organisations have various type of knowledge so that identifying and examination of them result to create, disseminate and management of knowledge more effectively. As Orlikowski (2002) stated this perspective is related to classification. Researchers by using these taxonomies investigate techniques, strategies and tools for capturing, coding, disseminating knowledge which is appropriate to each category of knowledge. For example, Zack (2002) applied this approach to KM and classified knowledge in three categories: core knowledge, advanced knowledge and innovative knowledge.

Second perspective states that knowledge is inseparable from know-how of doing work in complicated environment. The main emphasis of this perspective is on people and nature of their work.

Third perspective implies that organisational knowledge is inseparable from policies and power. This perspective state that knowledge is related to power and vice versa. Third approach is largely neglected in KM researches (Guo and Sheffield, 2008).

Donate and de Pablo (2015) stated that the main goal of an organisational KM initiatives is to gain awareness of its knowledge, individually and collectively, and to shape itself in such a way as to make the most effective and efficient use of the knowledge the firm has or is able to obtain.

### 2.2 Critical reviews of KM literature

In the last decade, research within the domain of KM has increasingly grown and got attention from both academics and business. Due to the enormous number of published papers in this field, it is worth to review them critically in order to reveal theoretical basics, research paradigm, methodologies, and content as well as research gap. As Guo and Sheffield (2008) asserted KM researchers still have to build their field anew. In the other hand, the publication amount of maturity-related topics steadily rose too. Conducting studies to structure and analyse the available literature of the field of maturity model research is vital (Wendler, 2012). Therefore, some KM literature reviews and maturity research literature reviews have been published. Table 1 represents a major list of KM and maturity studies reviews.

<table>
<thead>
<tr>
<th>Article</th>
<th>Field</th>
<th>Number of reviewed papers</th>
<th>Time period</th>
<th>Research method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dorasamy et al. (2013)</td>
<td>KM</td>
<td>51</td>
<td>1990–2011</td>
<td>Systematic review</td>
</tr>
<tr>
<td>Dwivedi et al. (2011)</td>
<td>KM</td>
<td>1,043</td>
<td>1974–2008</td>
<td>Meta analysis</td>
</tr>
<tr>
<td>Nie et al. (2009)</td>
<td>KM</td>
<td>1,870</td>
<td>1987–2008</td>
<td>Domain analysis</td>
</tr>
</tbody>
</table>
Table 1 A list of KM and maturity reviews (continued)

<table>
<thead>
<tr>
<th>Article</th>
<th>Field</th>
<th>Number of reviewed papers</th>
<th>Time period</th>
<th>Research method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lee and Chen (2007)</td>
<td>KM</td>
<td>2,405</td>
<td>1998–2005</td>
<td>Author co-citation analysis (ACA) and pathfinder network (PFNET)</td>
</tr>
<tr>
<td>Staples and Niazi (2008)</td>
<td>Maturity research</td>
<td>43</td>
<td>-</td>
<td>Systematic literature review</td>
</tr>
</tbody>
</table>

By looking to Table 1, it is obvious that all of studies accomplished in KM generally therefore none of them met the aims of this mapping study. As mentioned above, this study conducted to review systematically KM maturity researches which have not been considered in previous review studies. Systematic literature reviews provide the opportunity to synthesise and reflect on previous theoretical study, thus providing secure grounding for the advancement of knowledge (Hansen et al., 2004).

2.3 Knowledge management maturity model

To obtain understanding why they are used and what KM maturity models are, following section discusses them. This section look at KM maturity models from four aspects:

1. definition of maturity model and their application logic
2. their purpose and benefits
3. their basic structure
4. their development.

KM evaluation is essential component of KM implementation success (Chen and Fong, 2012). To assessment of company’s position regarding KM, the questions raise what needs to be measured and how in order to assess the as-is situation of KM in a given company and to assign it a degree of maturity. Therefore, companies required supportive
instrument to assess the current situation of KM, identify and prioritise improvement activities and consequently monitor the progress of KM implementation. KM maturity model assists organisations in evaluating KM projects and adopting appropriate strategy for growth (Kruger and Johnson, 2010). Maturity models are considered as a vital tool because they allow for a better positioning of the organisation and help find better solutions for change (Becker et al., 2009). Maturity models are a natural application of the life-cycle approach (Hsieh et al., 2009). A maturity model consists of a sequence of maturity levels for key process areas or activities which a given entity like KM develops through stages of maturity over time until it reaches the highest level.

Regarding KM maturity model purpose and benefits can state that a KM maturity model:

- Allows companies to understand the current position of KM systematically and make a holistic assessment of KM activities.
- Provides companies a roadmap from starting point to achieve intended objectives regarding KM. This KM implementation journey identifies steps and critical activities for implementation.
- Provides companies and people involved in KM a holistic view of KM and facilitates communication and mutual understanding of different views on the nature of KM, its barriers and appropriate strategies (Lee et al., 2010; Hsieh et al., 2009).

Regarding KM maturity model structure, it is clear that available maturity models differ in their structure like maturity model in wider domain of IS (Wendler, 2012). However, every maturity model should consist of two fundamental component to meet its purpose regarding to determine the as is position of KM. The first, a set of levels or stages, describing the development of the KM in an obvious way. These levels should be sequential and propose a continuous improvement. The second, a set of criteria for assessment which related to KM capabilities. Since KM is multi-dimensional concept, KM maturity models also have to consider key aspect of KM in their criteria definition.

Finally, it will be important to design a maturity model based on a sound methodological basis. The development process of new KM maturity model must be followed from design science paradigm (Poeppelbuss et al., 2011; Wendler, 2012; Becker et al., 2009). In fact, design oriented research are often used when maturity models are developed. When new maturity models are developed it is not adequate to design them in term of content and structure. According to design science paradigm, they have to be validated and also tested for applicability. Becker et al. (2009) identified seven requirement of design process of maturity model based on design science paradigm:

1. comparison with existing maturity models
2. iterative procedure
3. evaluation
4. multi-methodological procedure
5. identification of problem relevance
6. problem definition
7. targeted publication of results.
They also proposed a procedure model for the development of maturity models which can be used for KM maturity model development.

3 Research methodology

During the last two decades the publication amount of maturity model has steadily increased (Patas, 2012). Also in KM field, maturity model research is attaining more attentions. Yet until now, no studies have been available analysing and summarising the findings of the field of KM maturity model research. Therefore, the objective of this paper is to structure and analyse the available literature of the field of KM maturity model research to identify the studied dimensions of this field as well as research gaps. In order to gain main research objective, this study examines the KM maturity theoretical perspectives, research paradigms, and research methods and generally it see what they tell us about KM maturity researches as a whole. The mapping study delivers the first systematic summary of maturity model research. The categorisation of available publications helps researchers gain an overview of the state-of-the-art research and current research gaps. Therefore, systematic literature reviews, as suggested by Wendler (2012), Staples and Niazi (2008), Hansen et al. (2004) are an appropriate way for obtain comprehensive insights. A systematic review study is a defined and methodical way to summarise the previous studies concerning to specific topics, in order to identify missing areas in current research or to offer background to rationalise new research (Staples and Niazi, 2008). Moreover, a mapping study – as a specific form of literature review – recommended to review a relatively broad topic by aim of identifying, analysing, and structuring the goals, methods, and contents of conducted primary studies (Wendler, 2012).

The mapping study is trying to structure review systematically over the research field. The scope of this study is KM maturity model research by focusing on researches which developed new model. Wendler (2012) proposed comprehensive research framework in maturity model research. This framework offers four main topic areas in maturity researches: maturity model development, maturity model application, maturity model validation and meta article. This paper concentrates on developed KM maturity model to review.

To increase the rigor of systematic literature reviews the process of searching the related literature has to made as understandable. The steps we applied in finding relevant papers are list as follows:

1 Apply keywords (KM maturity, KM roadmap, KM growth, KM stage model) search into scientific databases and conference websites in KM, IS and management. Some of these databases are Science direct, Emerald, EBESCO, IEEE, Wiley, ProQuest and so on. The selected initial papers were published between 2000–2014 and written in English.

2 Duplicates are removed from initial papers.

3 Reading of title, abstract and keyword the papers.

4 Scanning of the whole content and find relevant papers to paper scope.
After the iterative and recursive literature search 22 maturity models are identified. Some maturity models of KM developed by individual researchers and found in the academic publications (Khatibian et al., 2010; Lee et al., 2010; Serna, 2012). While some were traced back to the reports and white papers produced by several international institutions (APQC, 2008; Infosys, 2000; KPMG Consulting, 2000).

By considering objective of this paper, the research questions concentrate on structuring and classifying the area of KM maturity model field. Research questions of this mapping study are:

- **RQ1**: What are the main dimensions of KM maturity model research?
- **RQ2**: What are the basic structure and architecture of maturity model?
- **RQ3**: What are the most common paradigms applied in KM maturity model researches?
- **RQ4**: What are the most common research designs applied?
- **RQ5**: What are the most common research methods/strategies used?
- **RQ6**: Is developed maturity model validated via strong research method(s)?

## 4 Classification framework

The main idea about the criteria for classifying KM maturity research can be obtained from the preliminary study of the KM maturity model and IS maturity model field in general. After deep study about nature and architecture of maturity model, a simple classification framework was used for analysing the selected papers and categorise the KM maturity model.

The classification framework of this study has simultaneous consideration of paradigmatic and methodological concerns as well as research content. The used criteria for categorising are explained in below:

### 4.1 Research design

The choice of the research design influences the way in which a researcher collects, interprets, and analyses data. Classification of the studies in this section was according to its research design which is quantitative, qualitative or both of them.

Quantitative research involves statistical and numerical measurement of the raw data typically captured in the questionnaires. It generally involves large numbers of people and captures an aggregate of individual responses (Keegan, 2009). While qualitative research methods were developed in the social sciences to enable researchers to study social and cultural phenomena. Some examples of qualitative methods are action research, case study research and ethnography (Myers, 2009). This kind of research focuses on theory-building or literature review.

### 4.2 Research method/strategy

The concepts within the category research method/strategy were adapted from Wendler (2012) which provided lists about used methods in IS research. By reviewing
articles most appropriate method was selected for classifying. Some of research methods/strategies are case study, action research, literature review, concept development, survey, grounded theory and others.

4.3 KM paradigm/theoretical foundations

Many researchers have proposed various theoretical approach or philosophical foundations about KM. By applying Burrel and Morgan’s (1979) study, Schultze and Leidner (2002) identified four research paradigms in KM namely: Normative, interpretive, critical and dialogic. The differences between these paradigms are defined in two dimensions. The first dimension is related to epistemology. There is a spectrum in epistemology from objectivism approach to subjectivism approach. From objective approach, knowledge is considered as an object waiting to be discovered. From subjective approach, knowledge is placed in social practice of communities and cannot exist independently of human experience, social practice and it is dynamic and active. The second dimension of the framework is related to social order which has two prominent view including dissensus and consensus. A consensus view characterises a research that seeks order and regards the making of order and stability as a normal and even necessary state of natural and social systems. Consensus research assumes that knowledge is coherent and more or less universal. In contrast, the dissensus view characterises a research that considers conflict and tension as a natural state. Dissensus research assumes that these phenomena are multiple, conflicting, and fragmented (Schultze and Leidner, 2002).

Normative approach to KM is related to codification, normalisation of experience and exploration law-like relationships. Thus, its finding is cumulative and generalised. Looking for establishing universal laws and causal relationships through hypothesis testing by typically relying upon mathematical methods. Interpretive approach focuses on organisational and social issues and assumes that people in organisations are viewed as active sense-makers, engaged participants, and creators of organisational life. Critical approach is related to discover inequities and challenge them. This implies that the reformation of social order is the aim of researchers participating in the critical paradigm. Dialogic approach is similar to the critical approach in its concern about domination but it differs from it in that the former considered power and dominance as situational factor rather than owned by individual or things. Among four KM approach of Schultze and Leidner (2002), normative approach is heavily prominent paradigm in KM research (Serna, 2012; Vorakulpipat and Rezgui, 2008; Guo and Sheffield, 2008).

Serna (2012) cited that outstanding prospects including functionalist and interpretativist. In the functionalist approach, knowledge is seen as a static entity that exists in a number of ways and places. In the second approach, knowledge is not separately from human experience, social practice and it is dynamic and active. Like general domain of IS, Guo and Sheffield (2008) and Schultze (1998) defined and distinguished between tree common paradigm in KM: functionalist, interpretive and critical. This study applies this classification of KM approaches and paradigms.

4.4 Research content

The concepts in the category research content emerged gradually by analysing the articles. Each article was reviewed iteratively to summarising the content in a coarse way.
The main components of maturity model are: the maturity dimensions specially definition of areas that KM projects should address, the maturity or capability levels along with summery description of each levels and assessment mechanisms of KM maturity, key activities or factors related to each levels to present roadmap for improvement.

Fraser et al. (2002) proposed a typology of maturity models. Their typology divides maturity models in to three basic groups: maturity grids, CMM-like model and Likert-like questionnaires.

The maturity grid typically contains descriptions for each activity at each maturity level. The Likert-like questionnaire can be considered to be a simple form of maturity model. In this kind of maturity model, the questions is a statement of good practice and the respondent are asked to evaluate the performance of organisation on a scale from 1 to n. The CMM family of models have a special structure which is more complicated. In the CMM family models, a number of key process area or activities are located at each level. Although general descriptions of maturity are stated for each level, there are no individual descriptions for each activity at each maturity level (Fraser et al., 2002).

4.5 Based model for maturity model structure

Based on this criterion, articles have been checked that whether or not borrowed their initial structures from CMMs? CMMs evaluate the capabilities of intended entity on five different maturity levels. They include the necessary elements of effective processes and describe an evolutionary improvement path from ad hoc to mature processes. CMMI is the successor to CMM and it has two representations: staged and continuous. In staged representation, an improvement roadmap was represented for critical factors in each maturity level. In continuous representation, capability levels of each key factors or process area are analysed separately (Ngai et al., 2013).

4.6 Validation of developed maturity model

Many researchers have become increasingly interested in identifying of guidelines that are aimed to support more rigorous development process of maturity model (Wendler, 2012; Poeppelbuss et al., 2011; Becker et al., 2009). This criterion is related to one of the critical guideline in maturity model development which must be based on design science guideline. Design science intends to improve problem-solving capabilities by creating new artefacts such as constructs, models, methods and instantiations (Becker et al., 2009). As Wendler (2012) mentioned, one of the important criteria for development maturity models is that developed maturity model has to be validated via rigorous research methods. This is the most differentiating issue between design-oriented and pure conceptual maturity model development.

5 Results

In this section, the results are presented and described according to research questions and classification schema. A total of 22 KM maturity researches are classified. The analyses of selected papers are included in Table 2.
<table>
<thead>
<tr>
<th>Num.</th>
<th>KM maturity researches</th>
<th>Population/country of study</th>
<th>Maturity themes</th>
<th>Based model for basic structure</th>
<th>KM approach or philosophy</th>
<th>Research design</th>
<th>Research strategy</th>
<th>Maturity model components</th>
<th>Maturity levels</th>
<th>Are validated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>KPMG Consulting (2000)</td>
<td>Various companies in the world</td>
<td>People, process, content, and technology</td>
<td>Non-CMM-based</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Survey</td>
<td>General description of maturity level/criteria for evaluating each dimensions</td>
<td>Knowledge chaotic, knowledge aware, knowledge focused, knowledge managed, knowledge centric</td>
<td>No</td>
</tr>
<tr>
<td>S2</td>
<td>InfoSys Company (2000)</td>
<td>Technological company</td>
<td>People, process and technology</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Case study</td>
<td>Description of maturity level/maturity dimensions/ lack of criteria for maturity</td>
<td>Initial, managed, defined, quantitatively managed, optimising</td>
<td>No</td>
</tr>
<tr>
<td>S3</td>
<td>Gallagher and Hazlett (2000)</td>
<td>Knowledge infrastructure, culture, technology</td>
<td>Non-CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Content analysis of semi-structured interviews</td>
<td>General description of maturity level/maturity dimensions/lack of criteria for maturity assessment</td>
<td>k-aware, k-managed, k-enabled, k-optimised</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td>Lee and Kim (2001)</td>
<td>Korean companies</td>
<td>Organisational knowledge, knowledge workers, knowledge process and IT</td>
<td>Non-CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Multi case study and content analysis</td>
<td>Maturity matrix/description of activities belong to each level/identify the feature of each dimensions in each levels</td>
<td>Initiation, propagation, integration, networking</td>
<td>Yes</td>
</tr>
<tr>
<td>S5</td>
<td>Kulkarni and Louis (2003)</td>
<td>Intel computer company</td>
<td>Lesson learned, expertise, data and structured knowledge</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Case study</td>
<td>Maturity levels/general checklist for evaluating level of each dimensions</td>
<td>Possible, encouraged, enabled/practiced, managed, continuously improved</td>
<td>No</td>
</tr>
<tr>
<td>S6</td>
<td>Siemens Company (2004)</td>
<td>Siemens company</td>
<td>Knowledge strategy and goals, environment and partnerships, people and competencies, collaboration and culture, leadership and support, knowledge structures and knowledge forms, technology and infrastructure, process, roles and organisations</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>-</td>
<td>Maturity level/maturity dimensions/criteria for measurement</td>
<td>Initial, repeated, defined, managed, optimising</td>
<td>No</td>
</tr>
<tr>
<td>No.</td>
<td>KM maturity researchers</td>
<td>Population/country of study</td>
<td>Maturity themes</td>
<td>Based model for basic structure</td>
<td>KM approach or philosophy</td>
<td>Research design</td>
<td>Research strategy</td>
<td>Maturity model components</td>
<td>Maturity levels</td>
<td>Are validated?</td>
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<tr>
<td>S7</td>
<td>Mohanty and Chand (2004)</td>
<td>IT consulting company</td>
<td>People (people and culture), process (process, policies and strategy), technology (technology and infrastructure)</td>
<td>Non-CMM-based</td>
<td>Functionalist</td>
<td>-</td>
<td>-</td>
<td>Maturity levels/maturity dimensions/lack of criteria for maturity assessment</td>
<td>Initial, intent, initiative, intelligent, innovative</td>
<td>No</td>
</tr>
<tr>
<td>S8</td>
<td>Natarajan (2005)</td>
<td>Software industries in India</td>
<td>Business process/readiness, technology and infrastructure, human behaviour, leadership</td>
<td>Non-CMM</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Case study</td>
<td>Description of maturity levels/maturity dimensions/lack of criteria for maturity assessment</td>
<td>Four stage with no labels for them</td>
<td>No</td>
</tr>
<tr>
<td>S9</td>
<td>Robinson et al. (2006)</td>
<td>UK construction firms</td>
<td>Establish goals and align KM strategy with business strategies, leadership and resources, IT and non-IT matter support of implementation, identifying required revisions for removing barriers, required criteria for performance evaluation</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Qualitative/quantitative</td>
<td>Survey/case study</td>
<td>Maturity roadmap: maturity level/dimensions belonged to each stages</td>
<td>Start-up, take-off, expansion, progressive, sustainability</td>
<td>No</td>
</tr>
<tr>
<td>S10</td>
<td>Lin (2007)</td>
<td>Large Taiwanese organisations</td>
<td>KM processes, KM effectiveness, socio-technical support</td>
<td>Non-CMM</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Survey</td>
<td>Maturity level along with general description/maturity dimensions with criteria for maturity assessment</td>
<td>Initial, development, mature</td>
<td>Yes</td>
</tr>
<tr>
<td>S11</td>
<td>Kruger and Snyman (2007)</td>
<td>Industries of South Africa</td>
<td>KMT management, information management, KM issues (principles, policies and strategies), implementation of KM, ubiquities knowledge, assessment of knowledge growth</td>
<td>Non-CMM-based</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Survey</td>
<td>Lack of descriptions and labels of maturity levels; just use seven levels/maturity dimensions with checklist related to them</td>
<td>Seven levels with no labels</td>
<td>No</td>
</tr>
<tr>
<td>Num.</td>
<td>KM maturity researches</td>
<td>Population/country of study</td>
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<tr>
<td>S12</td>
<td>APQC (2008)</td>
<td>Best practices of various companies throughout the world</td>
<td>Strategy, people, process, content and technology</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Survey</td>
<td>Maturity level with general descriptions of them/maturity dimensions along with criteria for their assessment</td>
<td>Getting started, explore and experiment, pilots and KM initiatives, expand and support, rationalise KM</td>
<td>No</td>
</tr>
<tr>
<td>S13</td>
<td>Rasula et al. (2008)</td>
<td>-</td>
<td>Knowledge related factors, organisation-related factors, IT-related factors</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Literature review</td>
<td>Maturity level with general descriptions of them/maturity levels/criteria for assessment of each dimension</td>
<td>Startup, take-off, expansion, progressive, sustainability</td>
<td>No</td>
</tr>
<tr>
<td>S14</td>
<td>Hsieh et al. (2009)</td>
<td>Industries of Taiwan</td>
<td>Culture, KM process and IT</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Quantitative/qualitative</td>
<td>Content analysis, focus group, case study</td>
<td>Maturity level with general description of them/maturity levels and criteria for assessment of each dimension</td>
<td>Knowledge chaotic stage, knowledge conscientious stage, KM stage, KM advanced stage, KM integration stage</td>
<td>Yes</td>
</tr>
<tr>
<td>S15</td>
<td>Pan and Kankanahalli (2009)</td>
<td>Multi-unit IS organisation of a large public university of Singapore</td>
<td>People, process and KM technology</td>
<td>None-CMM-based</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Case study</td>
<td>Maturity matrix/description of maturity levels/checklist of each maturity dimensions</td>
<td>Initial, aware, defined, managed, optimising</td>
<td>No</td>
</tr>
<tr>
<td>S16</td>
<td>Lee et al. (2010)</td>
<td>A financial Korean company</td>
<td>Based on CSFs of COP</td>
<td>None-CMM-based</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Multi-case study</td>
<td>Stage representation/criteria for each CSFs of COP</td>
<td>Building, growth, adaptive, close</td>
<td>No</td>
</tr>
<tr>
<td>S17</td>
<td>Khatri et al. (2010)</td>
<td>Software provider companies</td>
<td>Strategy, leadership, culture, evaluation, organisational structure, IT, process and HR</td>
<td>CMM1-based</td>
<td>Functionalist</td>
<td>Quantitative</td>
<td>Survey/case study</td>
<td>Stage representation/criteria for assessment of each maturity dimensions</td>
<td>Initial, managed, defined, quantitatively managed, optimising</td>
<td>Yes</td>
</tr>
<tr>
<td>Num.</td>
<td>KM maturity researches</td>
<td>Population/country of study</td>
<td>Maturity themes</td>
<td>Based model for basic structure</td>
<td>KM approach or philosophy</td>
<td>Research design</td>
<td>Research strategy</td>
<td>Maturity model components</td>
<td>Maturity levels</td>
<td>Are validated?</td>
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<tr>
<td>S18</td>
<td>Arling and Chun (2011)</td>
<td>Manufacturing company of rocket propulsion and space exploration engines for the defense industry</td>
<td>Knowledge creation</td>
<td>None-CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Case study</td>
<td>Maturity matrix</td>
<td>Siloed knowledge, standardised knowledge, integrated knowledge, generative knowledge</td>
<td>No</td>
</tr>
<tr>
<td>S19</td>
<td>Boote Ekionea et al. (2011)</td>
<td>-</td>
<td>KM infrastructure, KM process, KM skills and competencies</td>
<td>None-CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>-</td>
<td>Maturity matrix</td>
<td>Localised exploitation, internal integration, re-engineering, network re-design, redefinition of the business mission</td>
<td>No</td>
</tr>
<tr>
<td>S20</td>
<td>Serna (2012)</td>
<td>-</td>
<td>Resource management, analytic management, significant management, active management</td>
<td>None-CMM-based</td>
<td>Interpretivism</td>
<td>Qualitative</td>
<td>-</td>
<td>Maturity matrix</td>
<td>Disposed, reactive, appreciative, organised, optimised</td>
<td>No</td>
</tr>
<tr>
<td>S21</td>
<td>Zhao et al. (2012)</td>
<td>Consultancy company in China</td>
<td>Knowledge assets management, knowledge activities management, promotion processes of KM, KM enablers</td>
<td>None-CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Case study</td>
<td>Maturity level/maturity dimensions/lack of criteria for assessment</td>
<td>Static KMS, dynamic KMS, integration gateway of knowledge application, intellectual asset management system</td>
<td>No</td>
</tr>
<tr>
<td>S22</td>
<td>Chen and Fong (2012)</td>
<td>Construction firms in Hong Kong</td>
<td>Knowledge governance mechanisms and knowledge process</td>
<td>CMM-based</td>
<td>Functionalist</td>
<td>Qualitative</td>
<td>Survey</td>
<td>Maturity levels/maturity dimensions with criteria for assessment</td>
<td>Undeveloped, underdeveloped, developing, developed, highly developed</td>
<td>Yes</td>
</tr>
</tbody>
</table>
5.1 Time distribution of research

The analysis of publication year of KM maturity studies between 2000–2014 reveals that about 36% of studies (eight studies) are published before 2006 and about 64% of studies (14 studies) are published after 2006 (Figure 1). This indicated that interest in this field of research has increased over time.

Figure 1  Distribution of studies by period of time (see online version for colours)

5.2 KM maturity content (RQ1)

In order to respond RQ1, investigating KM maturity dimensions reveals that most frequent themes are IT, process and people as mentioned before by Pee and Kankanhalli (2009). For analysis frequency of maturity themes, selected studies are reviewed iteratively to reveal actual meaning of themes. For example, Gallagher and Hazlett (2000) stated that KM infrastructure as a maturity dimension referred to KM process and content. Figure 2 shows six most frequent themes in KM maturity models. Content, KM strategy and culture are other dimensions that were emphasised in KM maturity models.

Figure 2  Mostly frequent dimensions of KM maturity models (see online version for colours)

5.3 Maturity model structure/architecture (RQ2)

By considering RQ2, the structure of KM maturity model was analysed in an iterative process. The results show that only nine studies (about 41%) used CMM family models structure and 13 studied (about 51%) applied authors own structure (Figure 3). This result is differ from Wendler’s (2012) findings in IS maturity model which stated that CMM and CMMI structures is dominant in IS maturity field. CMM-based models are organised
on five maturity levels which prioritised required activities for increasing KM maturity. CMM-based models typically describe best practices related to each level and supports process improvement by providing evolutionary path that offers improvement roadmap. In non-CMM-based models, authors have proposed themselves structure for maturity levels.

Figure 3  Used maturity models for basic structure of new model (see online version for colours)

Maturity levels definition is one of the vital components of KM maturity architecture. Selected studies are also examined to determine their maturity stages. Most of them use five stages for maturity model structure (13 studies, 59%). Other studies used four, three and seven stages in maturity roadmap (Figure 4).

Figure 4  Distribution of selected studies per maturity stages (see online version for colours)

5.4 Research paradigms (RQ3)

To answer RQ3, as mentioned above, KM researches could be classified into three paradigms namely functionalist, interpretivist and critical. Since not all authors clearly identify their research paradigm, careful attention is given to these criteria. Findings show that only one study (S20) used interpretivism perspective and other studies (21 studies) applied dominant KM paradigm namely functionalist (Figure 5). No study use critical perspective in KM maturity model development.
5.5 Research design (RQ4)

To answer to RQ4, selected studies were analysed regarding to research design features and categorised them in three main groups: quantitative, qualitative and mixed method. The number of studies with quantitative and qualitative research design does not have much difference. As shown in Table 2, the research design of study 7 (S7) are not identified clearly. From 21 remain studies, nine studies used quantitative approach and ten of them used qualitative research design. Just two studies (S9, S14) applied mixed methods approaches (Figure 6).

5.6 Research methods/strategies (RQ5)

The dominant research strategies of studies is case study (S2, S4, S5, S8, S9, S14, S15, S16, S17, S18, and S21) and the second common research strategy is survey (S1, S9, S10, S11, S12, S17, S22). See Figure 7 for more details about research strategies in KM maturity models. The research strategies of some studies (S6, S7, S19 and S20) are not clearly described and some of studies applied more than one research strategy.
5.7 Validation of developed Maturity models

As mentioned above, development of maturity models obey design science principles. One of the key principles in design science is validation of developed models via proper research methods. Hence, as Wendler (2012) and Bruin et al. (2005) mentioned, validation of maturity models are so important.

Looking at the development procedure of examined studies reveals that most of them do not validated developed model by rigorous research methods. The results show conceptual designs outweigh design oriented model development in KM maturity field. The examination of entire studies reveals that many KM maturity models, like IS as general (Wendler, 2012), suffer a lack of appropriate validation of their content and structure. Only five studies (S4, S10, S14, S17, and S22) validated their new models via suitable research methods (see Figure 8).

6 Conclusions

Until today, no studies have been available summarising the activities and results of KM maturity model research. This study tries to represent comprehensive research framework of academic papers related to KM maturity studies that answer to questions about applied
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research paradigm, methods, and content and maturity model structure. The answers to research questions provide holistic insight for both researchers and practitioners. Both researchers and professionals can benefit from the research findings. The study findings are summarised as follows:

Results indicate interest in maturity models has increased during the last years which are shown by enhancing numbers of studies in this field. Looking at maturity dimensions in maturity model research, mostly frequent dimensions are IT, process and people. As mentioned in most studies (Kruger and Johnson, 2010; Hsieh et al., 2009), major focus current KM maturity model is technological aspect.

As results showed, author’s own structure/non-CMM-based model is dominant as basic structure for KM maturity models. Looking especially at the KM paradigms/approach, functionalist is prominent approach in developing maturity models. As Figure 5 shows qualitative research design are mostly used in KM maturity researches. Case study is prominent research strategy in KM maturity researches. Most of the maturity researches are organised on five stages of maturity. Finally, considering development procedures of maturity models revealed that conceptual designs outweigh design-oriented model developments. This has significant findings for validation.

The main research contribution are as follows: First, it is structuring the existing literature of the KM maturity researches to identify their theoretical foundations as well as research gaps via a comprehensive way which is not considered until now. Second, the research classification framework systematically compare existing KM maturity models regarding structures, contents, research design, underlying theories, assumptions, and research methods. Third, it provides a valuable insight for researcher in KM maturity model development to guide research activities.

On the other hand, although the findings of this study are remarkable, there are some limitations in this research. The selection process of researches in mapping study causes the elimination of certain publication types. Literature was encompassed selectively by focusing on journals, validated international institutes studies and international conferences. These restrictions support the research aim of the study but are still a threat to completeness. The focus on research articles is also the reason for the relatively small proportion of maturity models. As mentioned before, the scope of this study contains just articles focused on maturity model development.

Due to the limitations of the study, future research may complete the literature basis and classification framework can be applied to all domains of KM maturity model, other publication types and new publications.

7 Implications

The results indicate that certain research gaps currently exist. First of all, KM maturity models like maturity models in general domain of IS, are developed based on conceptual research without validation of them by proper and accurate research methods. Looking at results, it turned out that the majority of developed models were based on conceptual design. Just five studies assessed validity of developed models.

By examining KM maturity model components, most of the models have ambiguous and general maturity assessment mechanism. They identified dimensions without defining clear criteria for determine capability level and finally KM maturity level. Most of them do not offer a roadmap for KM improvement and do not prescribe strategies for
growth. Some studies (S2, S6, S8, S7, S9, S18, S19, S20, and S21) have not certain
criteria for assessing capability level of each dimension. The analysis of applied research
design and strategies revealed that there were still one study without recognisable
research design (S7) and four studies with no clear research strategy at all (S6, S7, S19
and S20).

This reviewing and analysis of previous KM maturity models is a scar in most of
selected studies. As already mentioned in process model by Becker et al. (2009), authors
intending to develop new maturity models should carefully review existing maturity
models.

Finally, as shown in Table 2, KM maturity models often mentioned various
dimensions especially technical aspect of KM (see Figure 2). Despite the importance of
KM-business alignment (Ale et al., 2014; Aboud Zeid, 2009; Evans, 2003), KM maturity
researches do not pay attention to it. The systematic KM maturity model for evaluating
and implementing KM aligned with business strategies is mostly missing. Ale et al.
(2014) mentioned that KM-business alignment is as the first requirement in developing
KM reference model which is omitted in KM maturity researches. Just one research (S6)
cited the importance KM-business alignment but do not offer any clear criteria for
assessing capability levels of this critical.

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