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ABSTRACT

Knowledge management often refers to various theories and definitions. However, there is a lack of consensus on what exactly knowledge management is and what constitutes a knowledge management system. We are engaged in research into the development of knowledge management systems from principles of practical knowledge management uncovered by a thorough analysis of the literature. As a precursor to field work with ‘knowledge practitioners’ we have conducted our analyses on the ‘practices’ embodied in seminal work of scholars, even as they have changed for individual researcher over time. Thus this paper explains our approach in attempting to identify elements of knowledge management systems according to scholars’ texts in the literature.

1 INTRODUCTION

Despite the recent emergence of knowledge management (KM) as an explicit domain of research, it has roots and is influenced by a variety of disciplines such as philosophy, cognitive, social, economics, management, and information sciences, as well as knowledge engineering and artificial intelligence (Kakabadse N. *et al.* 2003). As a result, various emergent philosophies, definitions, and theories of KM are circulating in literature as well as in practice. Yet, there is no clear consensus on the key elements that constitute a knowledge management system (KMS) in organisations – particularly computer-based KMSs. A (computer-based) KMS is a type of ‘information’ system as vaguely defined by IT specialists. Unfortunately, the related subdiscipline areas of information systems development, information systems engineering and databases do not have the right tools and techniques for *knowledge* management systems. Knowledge is different from *information* and *data* and its collection, storage, distribution, access and use demand different IT-related principles. This is the focus of our work.

Hence, in this inquiry, we try to answer the question: What are the key elements of a KMS in organisations? We use the term ‘elements’ in its broadest sense to mean the building blocks and processes used in KMS. To achieve this objective, we carry out a

systematic analysis of a number of scholars' texts to build an ontology of the elements that they advocate should be present in knowledge management systems. We follow an inductive strategy for building the ontology whereby the development is built bottom up, rather than approach the topic with any pre-conceived ideas of how such ontology should be like.

The idea behind this research is to consider articles of scholars in KM as interviews, and systematically and rigorously analyse them to discover common elements and add uncommon but useful ones.

The strategy for this inquiry could be summarised in the following steps:

- Find relevant texts in literature
- Identify and analyse concepts and categories of KMS in these texts
- Verify findings using comparative analysis

Accordingly, in this paper we present the analysis of selected texts in section two. We start by the analysis of Nonaka's article "The Knowledge-Creating Company" published in 1991, and Nonaka & Takeuchi's book under the same title published in 1995. Then we present Wiig's view on KMS in both his articles published in 1997 and 1999 in the journal of knowledge management. Following that we present Davenport and Prusak analysis in their book "Working Knowledge" published in 1998. Finally we present the work of both Bejerse in his articles published in 1999 and 2000, and Bhatt in his articles published in 2000 and 2001 in the journal of knowledge management. In section three, we provide a visual representation of the concepts that emerge from these texts through presenting a conceptual map for KMS.

2 ANALYSIS OF SELECTED TEXTS

In this section we discuss the concepts and categories that emerged from the texts of each scholar.

2.1 Nonaka (1991) & Nonaka and Takeuchi (1995)

We start by Nonaka's views on KM in his article "The Knowledge-Creating Company" originally published in 1991, and which was developed into a book under the same title, co-authored with Takeuchi, and published in 1995. Many scholars refer to this article and the book as a landmark and a turning point in the evolution of KM.

In his article Nonaka (1991) does not use the term 'Knowledge Management' explicitly, but points at 'Knowledge-creating' companies, and argues that only few managers grasp its true nature, let alone know how to manage it. He outlines KM activities in the following definition of "Knowledge-creating" companies:

...consistently create new knowledge, disseminate it widely throughout the organisation, and quickly embody it in new technologies and products.

The main concepts that emerge from Nonaka's definition are knowledge *creation*, *dissemination*, and *embodiment*. However, thorough analysis of his article reveals other concepts:

- testing knowledge
- using knowledge
- inventing new knowledge
- communicating knowledge
- sharing knowledge
- making personal knowledge available to others
- articulation
- converting knowledge
- learning
- translating knowledge
- standardising knowledge
- transferring knowledge

In his examples of knowledge-creating companies, Nonaka (1991) stresses on the importance of tacit knowledge and introduces a ‘knowledge spiral’ to model four interaction processes between the two forms of knowledge tacit and explicit. Later in their book, Nonaka & Takeuchi (1995) explicitly label the four processes: ‘socialisation’ from tacit to tacit, ‘externalisation’ from tacit to explicit, ‘combination’ from explicit to explicit, and ‘internalisation’ from explicit to tacit.

Creating knowledge is a broad concept that could mean *inventing* in the sense of exploring and discovering new knowledge, or *forming* in the sense of configuring and shaping existing knowledge. Although Nonaka (1991) specifies *creating* ‘new’ knowledge in his definition, he actually implies both aspects of knowledge creation: the generation of new knowledge as well as making existing knowledge available to others. He explicitly mentions *inventing new knowledge* and implicitly points to it in the case studies of Japanese companies in both his article (1991), as well as his book with Takeuchi (1995). However, Nonaka (1991) also points at configuring existing knowledge through making personal knowledge available to others. In fact, he specifies that *knowledge creation* takes place in ‘externalisation’, which is *converting* tacit knowledge to explicit knowledge.

The concept *knowledge dissemination* means spreading around or circulating knowledge. According to Nonaka (1991), *dissemination* is conducted through making knowledge available to others. This is achieved on the tacit as well as the explicit levels: *sharing* and *communicating* tacit knowledge through ‘socialisation’, and *sharing* and *communicating* explicit knowledge through ‘combination’ (Nonaka, 1991; Nonaka & Takeuchi, 1995). Moreover, Nonaka (1991) argues that *transferring* knowledge can be facilitated by *dialogue* and *communication*.

The concept *embody knowledge* entails the personification of knowledge. According to Nonaka (1991) *embodying knowledge* happens when knowledge is *transformed* from explicit to implicit through the act of ‘internalisation’. He further explains that this requires employees to broaden, extend, and reframe their own tacit knowledge. Furthermore, he talks about “making .. [knowledge] available for testing and use by the company as a whole”. The terms *testing* and *use* add two other concepts to *knowledge embodiment*, but this time on the level of the organisation.

In his definition of KM, Nonaka (1991) categorises activities in a KMS into *knowledge creation*, *dissemination*, and *embodiment*. However, other concepts emerge from the descriptions in the article and the book. These concepts appear to be related to the specified categories. The following is a preliminary classification of categories and sub-categories according to Nonaka (1991), and Nonaka and Takeuchi (1995):

- Knowledge Creation:

- Knowledge invention: discovering new knowledge
- Knowledge formation/configuration:
 - converting tacit knowledge into explicit knowledge (conversion)
 - combining explicit knowledge into a new whole (combination)
- Knowledge Dissemination:
 - Knowledge transfer: discussing (dialogue) and communicating (socialisation) knowledge (involves learning and articulating).
 - Knowledge sharing: making knowledge available to others
- Knowledge Embodiment:
 - Knowledge enrichment: understanding and transforming explicit knowledge into tacit knowledge (internalisation)
 - Knowledge testing: assessing existing knowledge

2.2 Karl Wiig (1997, 1999)

Wiig (1997) takes a radically different stand in his article in the inaugural issue of the Journal of Knowledge Management. He focuses on explicit knowledge more than tacit knowledge in his clear definition of KM:

KM is to understand, focus on, and manage systematic, explicit, and deliberate knowledge building, renewal, and application – that is, manage effective knowledge processes (EKP).

The terms *building*, *renewal*, and *application* are clear concepts in Wiig's (1997) definition of KM. However, he also uses terms to describe knowledge characteristics such as *systematic*, *explicit*, and *deliberate*, which mean methodical, clear, and purposeful respectively. These terms do not describe the elements of a KMS. However, it gives an indication that Wiig (1997) focuses on knowledge that can be articulated and that have a specified purpose. Moreover, it gives an indication that he views managing knowledge to be guided by procedures and techniques. In fact, Wiig (1997) specifies a method for KM from a managerial perspective that comprises four areas of emphasis:

1. Top-down *monitoring* and *facilitation* of knowledge-related activities.
2. *Creation* and *maintenance* of the knowledge infrastructure.
3. *Renewing*, *organizing*, and *transforming* knowledge assets.
4. *Leveraging* (*using*) knowledge assets to realize their value.

Accordingly, Wiig (1997) views *building*, *renewal*, and *application* as the main processes in a KMS. However, he further breaks down these processes to *monitoring* and *facilitation*; *creation* and *maintenance*; *renewing*, *organizing*, and *transforming*; and *leveraging* or *using* knowledge.

Wiig (1997, 1999) gives more importance to the concept of *capturing* existing knowledge, more than *inventing* new knowledge. He uses the terms *creating* and *building* associated with the concepts of *capturing*, *organising* and *deploying* existing knowledge. A better term used by Wiig (1997) is knowledge *exploitation*. On the other hand, Wiig (1997) focuses mainly on explicit knowledge, albeit mentioning the term *transforming*, which he does not explain. Nevertheless, Wiig (1999) acknowledges explicitly the importance of tacit knowledge. Accordingly, Wiig views

the concept of knowledge creation as *exploiting* existing knowledge through *capturing* and *organising* explicit and tacit knowledge.

The concepts *renewing* and *maintenance knowledge* emerge in Wiig's article (1997) along the same lines of Nonaka's (1991) concept of *embodying knowledge*. These concepts complement rather than substitute *testing* and *use* mentioned by Nonaka (1991). However, the concept *applying knowledge* mentioned by Wiig (1997, 1999) is synonymous to the concept *using knowledge* mentioned by Nonaka (1991). A better term is *utilisation*, which is used by Wiig (1999).

Although Wiig (1997, 1999) does not mention knowledge *dissemination*, concepts similar to Nonaka's (1991) emerge such as *share*, *distribute*, and *transfer knowledge*. For example, Wiig (1997) mentions knowledge *sharing* as part of a "knowledge strategy as business strategy". He also mentions knowledge *distribution* as part of "knowledge transfer strategy". However, the concept of *knowledge distribution* emerges here in the sense of deliberately sending "knowledge to points of action where it will be used to perform work" (Wiig, 1997).

In his definition of KM, Wiig (1997) categorises activities in a KMS into knowledge *building*, *renewal*, and *application*. Other categories are used in Wiig (1999): *build*, *apply*, and *deploy*. However, from the description in both articles other concepts emerge. These concepts appear to be more inline with Nonaka's categories. The following is a restructured classification of Nonaka's categories and sub-categories accordingly:

- Knowledge Creation:
 - Knowledge exploration: discovering and inventing new knowledge
 - Knowledge exploitation:
 - Knowledge conversion: converting/transforming tacit knowledge into explicit knowledge
 - Knowledge capturing: combining, and organising explicit knowledge into a new whole
- Knowledge Dissemination:
 - Knowledge transfer: discussing (dialogue) and communicating (socialisation) knowledge (involves learning and articulating).
 - Knowledge sharing: making knowledge available to others
 - Knowledge distribution: sending knowledge to points of action
- Knowledge Utilisation:
 - Knowledge embodiment: understanding and transforming explicit knowledge into tacit knowledge (internalisation)
 - Knowledge testing: assessing existing knowledge
 - Knowledge renewing and maintenance

2.3 Thomas Davenport and Laurence Prusak (1998)

Despite the lack of an explicit definition for KM in Davenport & Prusak's book "Working Knowledge" (1998), they provide a more pragmatic approach to describing processes in a KMS. They categorise KM concepts into knowledge *generation*, *codification and coordination*, and *transfer*. In fact, each of these concepts is discussed in a chapter by itself.

The concept of *knowledge generation* is used along the same meaning of *knowledge creation* to indicate both knowledge exploration and exploitation. As Davenport & Prusak (1998) explicitly clarify, “when we talk about knowledge generation, we mean the knowledge acquired by an organisation as well as that developed within it”. They further explain that acquired knowledge is knowledge that is new to the organisation, whether it is newly invented, purchased, or rented. Accordingly, another concept of knowledge exploration emerge in their chapter on knowledge generation: *knowledge acquisition*.

Another concept that emerges in Davenport & Prusak’s (1998) book is *knowledge codification* and *coordination*. They explain that through *codification* and *coordination* knowledge is turned into an organised, explicit, portable, and easy to understand form. *Knowledge codification* is used along the same meaning of *knowledge conversion*: to “convert knowledge into accessible and applicable formats”. However, Davenport & Prusak (1998) argue that some kinds of knowledge, such as tacit knowledge, are almost impossible to codify. They explain that the codification process of such knowledge is generally limited to locating it through *knowledge mapping*. “A knowledge map- whether it is an actual map, a knowledge “Yellow Pages,” or a cleverly constructed database- points to knowledge but doesn’t contain it”.

The concept of *knowledge transfer* means the relocation of knowledge. According to Davenport & Prusak (1998), the best way to transfer knowledge within organisations is through communication: “hire smart people and let them talk to one another”. They argue that knowledge is usually transferred between employees whether the organisation manage the process or not. A better term used by Davenport & Prusak (1998) for knowledge transfer within the organisation is *knowledge fusion*.

Davenport & Prusak (1998) categorise activities in a KMS into *knowledge generation*, *codification and coordination*, and *transfer*. However, from the description in ‘Working Knowledge’ other concepts emerge. These concepts appear to be inline with the previously stated categories. The following is a restructured classification of categories and sub-categories accordingly:

- Knowledge Creation:
 - Knowledge exploration:
 - Knowledge invention: discovering new knowledge
 - Knowledge acquisition: buying or renting new knowledge
 - Knowledge exploitation:
 - Knowledge conversion: transform knowledge into accessible and applicable formats (i.e. tacit knowledge into explicit knowledge)
 - Knowledge capturing: combining, and organising explicit knowledge into a new whole
 - Knowledge mapping: a map that points to knowledge but does not contain it.
- Knowledge Dissemination
 - Knowledge fusion: transferring knowledge through discussing (dialogue) and communicating (socialisation) knowledge (involves learning and articulating).
 - Knowledge sharing: making knowledge available to others

- Knowledge distribution: sending knowledge to points of action
- Knowledge Utilisation:
 - Knowledge embodiment: understanding and transforming explicit knowledge into tacit knowledge (internalisation)
 - Knowledge testing: assessing existing knowledge
 - Knowledge renewing and maintenance

2.4 Roelof P. uit Beijerse (1999, 2000)

Beijerse (1999) provides a more detailed definition of knowledge management based on a thorough definition of the terms management and knowledge. He analyses different definitions of management to derive his own: “Management is the strategy-driven motivation and facilitation of people, aimed at reaching the organizational goals”. Similarly, he analyses different definitions of knowledge to derive his own: “Knowledge is ... the capability to interpret data and information through a process of giving meaning to these data and information; and an attitude aimed at wanting to do so”. Finally, he analyses different definitions of KM and integrate all to derive the following definition of KM:

Knowledge management is achieving organizational goals through the strategy-driven motivation and facilitation of (knowledge-) workers to develop, enhance and use their capability to interpret data and information (by using available sources of information, experience, skills, culture, character, personality, feelings, etc.) through a process of giving meaning to these data and information.

In Beijerse’s (1999) definition of KM, he concentrates more on people and their motivation and emphasises the role of tacit knowledge. In fact, he views tacit knowledge as the added value to these processes. However, the concepts *develop*, *enhance* and *use* workers’ knowledge emerge to describe processes in a KMS. Moreover, he provides a chart of KM instruments that includes these processes in addition to a new emergent concept of determining the knowledge gap. These processes are classified according to Nonaka’s four knowledge interaction processes between tacit and explicit knowledge: ‘socialisation’, ‘externalisation’, ‘combination’, and ‘internalisation’.

Beijerse (1999, 2000) uses the term *develop* also in the sense of exploitation and exploration. Beijerse (1999) explains in his article that knowledge can either be built from internal resources (i.e. exploitation) or bought from external resources (i.e. exploration). Beijerse (2000) further distinguishes between the two terms and uses the concept *knowledge development* to point at *knowledge exploitation*, and the concept *knowledge acquisition* to point at *knowledge exploration*.

Another concept that emerges in Beijerse’s (1999) article is *enhancing knowledge*. He uses the term to incorporate *knowledge evaluation* as well as *knowledge improvement*. Beijerse (2000) further distinguishes between two terms *knowledge utilisation*, which is a knowledge stream that rests largely on the company culture, and the term *knowledge evaluation* of the utilised knowledge.

On the other hand, the concept *knowledge use* in this context incorporates *sharing*, *converting*, and *distributing knowledge* in addition to *applying knowledge*. Beijerse (1999) uses the term to mean essentially knowledge sharing. However, Beijerse (2000) further distinguishes between two terms *knowledge lock* to point at *changing knowledge* into structural and systematic form and making it available to everyone, and the term *knowledge sharing*, which is also a *knowledge stream* that is dependent on culture.

Although Beijerse's (1999) focuses more on knowledge workers and their motivation, he categorises processes in a KMS into *developing*, *enhancing* and *using knowledge*. Emergent concepts in Beijerse's (1999, 2000) are inline with the concepts and categories that emerged from previous scholars. Only some better terms are used to label these processes. The following is a re-labelled classification of categories and sub-categories accordingly:

- Knowledge Creation:
 - Knowledge exploration:
 - Knowledge invention: discovering new knowledge
 - Knowledge acquisition: buying or renting new knowledge
 - Knowledge exploitation:
 - Knowledge conversion: transform knowledge into accessible and applicable formats (i.e. tacit knowledge into explicit knowledge)
 - Knowledge capturing: combining, and organising explicit knowledge into a new whole
 - Knowledge mapping: a map that points to knowledge locations but does not contain it.
- Knowledge Dissemination
 - Knowledge fusion: transferring knowledge through discussing (dialogue) and communicating (socialisation) knowledge (involves learning and articulating).
 - Knowledge sharing: making knowledge available to others
 - Knowledge **streaming**: sending knowledge to points of action
- Knowledge Utilisation:
 - Knowledge embodiment: understanding and transforming explicit knowledge into tacit knowledge (internalisation)
 - Knowledge **evaluation**: measuring the value of knowledge
 - Knowledge renewing and maintenance: reconfiguring, modifying and deleting knowledge

2.5 Bhatt G. D. (2000, 2001)

In his article in the Journal of Knowledge management, Bhatt (2000) does not provide an explicit definition of KM. Instead, he cites different researchers in defining knowledge development cycle as the process of *knowledge creation* (Nonaka, 2004), *knowledge adoption* (Adler, 1989; Adler et al., 1999), *knowledge distribution* (Prahalad and Hamel, 1990), and *knowledge review and revision* (Crossan et al., 1999). However, in his article in the same journal, Bhatt (2001) defines the KM process as follows:

... *the knowledge management process can be categorized into knowledge creation, knowledge validation, knowledge presentation, knowledge distribution, and knowledge application activities.*

The concept *knowledge creation* is used inline with previously emergent concepts. Although Bhatt (2000) focuses on the *exploitation* aspect of knowledge creation, Bhatt (2001) asserts the importance of *knowledge exploration*. According to Bhatt (2001), knowledge creation refers to “the ability of an organisation to develop novel and useful ideas and solutions.” However, he also states that organisations can exploit internal knowledge through reconfiguring and recombining existing pieces of knowledge”.

Moreover, Bhatt (2000) uses the concept of *knowledge adoption* to point at *acquiring knowledge* from other sources and adapting it for organisational use. In addition, Bhatt (2001) discusses the concept of *knowledge presentation* to point at the organisation of explicit knowledge.

Bhatt (2000, 2001) uses the concept *distribution* in the sense of circulating and sharing knowledge. He argues that knowledge needs to be “distributed and shared throughout the organization, before it can be exploited at the organizational level.”

The final KM concepts discussed by Bhatt (2000) is *knowledge review and revision*. He uses the terms not only in the sense of evaluation but also to mean renew and maintain. He argues that “one of the important tasks for management becomes to review and replenish knowledge clusters continually in the organization.” Bhatt (2001) discusses the concepts *knowledge validation* and *knowledge application* separately. “Knowledge validation refers to the extent to which a firm can reflect on knowledge and evaluate its effectiveness for the existing organisational environment.” “knowledge application means making knowledge more active and relevant for the firm in creating values.”

Bhatt (2000) categorises activities in a KMS into *knowledge creation, knowledge adoption, knowledge distribution, and knowledge review and revision*. Bhatt (2001) categorises the KM process into *knowledge creation, knowledge validation, knowledge presentation, knowledge distribution, and knowledge application activities*. These concepts appear to be inline with the previously stated categories. There is no new concepts that emerged from Bhatt’s (2000, 2001) texts.

3 KNOWLEDGE MANAGEMENT SYSTEMS CONCEPTUAL MAP

According to the analysis that we present above, the main elements in a KMS *include*: knowledge creation, knowledge dissemination, and knowledge utilisation. We use the term *include* to point to an elective relationship between categories and their properties (sub-categories). In this sense, a category can comprise one or more of its properties.

Knowledge creation includes knowledge exploration and knowledge exploitation. Organisations can achieve knowledge exploration through inventing new knowledge and/or acquiring knowledge through buying or renting this knowledge. On the other hand, organisations can achieve knowledge exploitation through knowledge

conversion through transforming tacit knowledge into accessible and applicable formats, knowledge capturing by combining, and organising explicit knowledge into a new whole, and knowledge mapping by creating a map that points to knowledge locations.

Knowledge dissemination includes knowledge fusion, knowledge sharing and knowledge streaming. Organisations can facilitate knowledge fusion through knowledge conversion using dialogue and communication, knowledge sharing by making knowledge available to others, and knowledge streaming by sending relevant knowledge to points of action.

Knowledge utilisation includes knowledge embodiment, knowledge evaluation and knowledge renewing and maintenance. Organisations can achieve knowledge embodiment through facilitating understanding and transforming explicit knowledge into tacit knowledge (internalisation), knowledge evaluation by measuring the value of knowledge, knowledge renewing and maintenance by making knowledge available to others, and knowledge streaming by reconfiguring, modifying and deleting knowledge.

Figure 3 represents the categories and concepts that emerged from scholars’ texts:

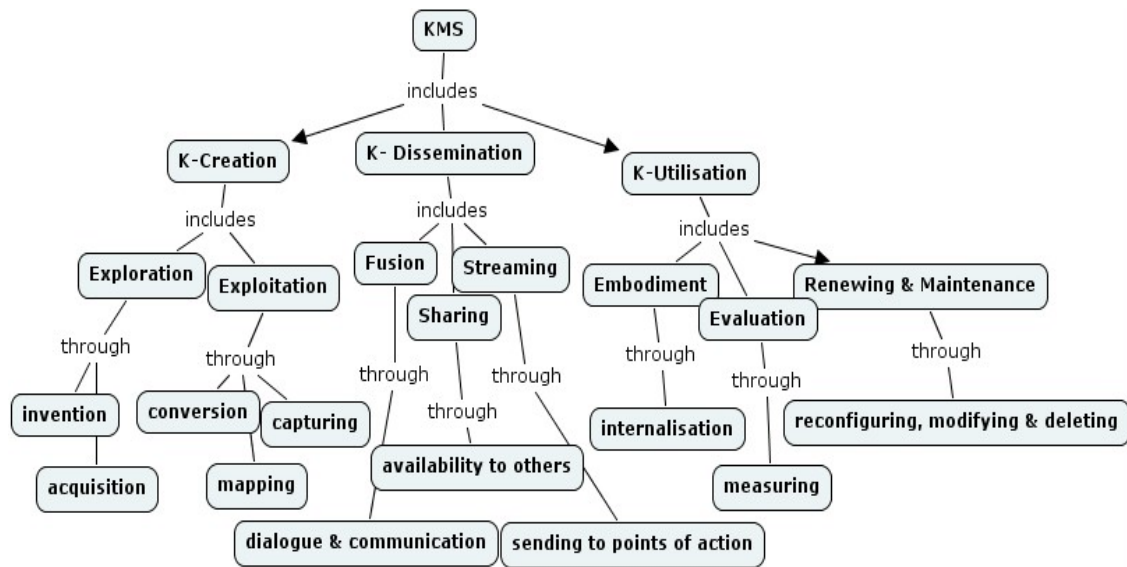


Figure 1. KMS Conceptual Map

CONCLUSION

In this inquiry we investigated scholar’s views and descriptions of KMS. We analysed nine articles and books for seven different scholars. Our analysis produced a wide range of concepts that emerged from these texts. These concepts are classified around central categories with relevant properties and dimensions. As a result, we developed a conceptual map illustrating KMS categories and concepts.

The KMS conceptual map and its categories and concepts were further validated against the data gathered from scholars' texts. It fits the descriptions of KMS by the authors chosen in this study.

The limitation of our inquiry is that it is based only on scholar views and their case study research of KMS. However, the presented conceptual map can incite further empirical research about the phenomenon. It can stimulate questions for investigating the views of 'knowledge practitioners' in organisations. This would allow for more realistic conceptual map and hence a well-integrated theory. In addition, it can be valuable to other researchers in the KM domain for further testing the theoretical propositions provided.

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