University of Hertfordshire

Towards a Knowledge Management Assessment Tool: The Operations Management Perspective

Desmond Kapofu

d.kapofu@herts.ac.uk

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d.kapofu@herts.ac.uk

Abstract

Practitioners are often confused by the wide range of Knowledge Management (KM) solutions that researchers and consultants offer. Part of this confusion is because they cannot determine how these solutions fit into their existing KM systems. KM assessment should be the starting point for any KM initiative yet extant literature provides little guidance in this area. In this paper we propose a tool that organisations can use to assess their Knowledge Management (KM) practices in order for them to make informed decisions and invest wisely. To that end we propose the Operations perspective of KM which encapsulates existing thinking. Our proposal goes further to outline key elements that a KM assessment tool must have and review existing tools against these elements. The KM assessment tool proposed in this paper has its roots in Quality literature and is ideal for assessing as well as designing KM systems.

Key words:
Knowledge, Assessment, Tools, Operations, Systems, Knowledge Management Solutions

1. Background

Knowledge Management (KM) has undeniably developed into a widely researched subject prompted by the realisation of the importance of KM in an organisation. The KM landscape is broad and multi-faceted with research initiatives ranging from knowledge creation (Nonaka and Takeuchi, 1995; Cook and Brown, 1999; Brown and Duguid, 1991), knowledge sharing and transfer (Handzic, 2003; Handzic and Chaikumngalanont, 2005; Alavi and Leidner, 2001), knowledge management strategies (Haggie and Knox, 2003), etc. It is evident from the extant literature that considerable consensus exists on the KM activities that organisations have to undertake in order to become competitive (Teece, 1998; Davenport and Voelpel, 2001). However, it is also noticeable that KM has its underpinnings in perspectives of how knowledge is created or what constitutes knowledge. It follows that the manner in which knowledge is produced determines its form/structure and hence influences the way in which it is managed in the organisation in terms of its storage, transfer/sharing and application. It is therefore unsurprising that approaches to KM follow two distinctive approaches which have been termed the cognitive and community approaches to KM (see Swan et al., 1999) although attempts have been made to combine the two approaches, for example Pan and Scarborough's (1999) "socio-technical" approach. The plethora of KM solutions and "packages" often

confuse organisations wishing to introduce or indeed improve KM (Earl, 2001). As duly noted by Binney (2001, p.33): " *the question is rarely, should I be making KM investments?, but rather given the range of KM options available, where should I be making my KM investments, balancing the options presented to me in literature?"* Considerable research has gone into structuring the KM landscape in order to help organisations to identify the types of KM solutions available and the processes or KM categories to which they belong. For example, Binney (2001) proposed the KM spectrum as a mechanism to inventory current KM-related activities in organisations. It was noted that most organisations have existing KM-related activities and investments that are not considered to be KM investments. These KM investments can be identified on the KM spectrum and used to help position and inventory the current KM practices of an organisation. Haggie and Kingston (2003) developed Binney's (2001) work further by adding a further category to Binney's KM spectrum and providing an overview of questions that need to be asked where an organisation is keen to select a knowledge management approach. This early work by Binney (2001) and Haggie and Kingston (2003) into KM assessment made two very important contributions to KM literature and practice: firstly it highlighted the non-technological elements that make KM implementation successful. Secondly, it recognised that the implementation of new KM initiatives requires an assessment of current KM performance including the recognition of informal practices. In essence, organisations need to look internally and establish the extent to which their existing practices are relevant and effective for their daily operations. This suggests that a method, tool or application that aids the assessment of organisational KM systems is necessary for there to be a sound basis for the improvement or introduction of KM initiatives in organisations. To that end, this paper reviews extant assessment tools and proposes an alternative KM assessment tool for this purpose. The KM assessment tool and methodology presented in this paper enables organisations to align their KM initiatives with their operational strategy. An operations definition of knowledge and KM is proposed and this provides the basis upon which the KM assessment exercise is undertaken. It is argued that the perspective of knowledge and KM presented here is theoretically holistic and also practical. The next section presents the operations perspective of knowledge and KM.

2. An Operations Management perspective of knowledge and KM

A widely accepted theory of knowledge is the natural progression from data to information to knowledge. As defined by Davenport et al., (1998), knowledge is information combined with experience, context, interpretation, and reflection. It is a high value form of information that is ready to apply to decisions and actions. The underlying implication of this conceptualisation is that knowledge can be an independent entity outside a "knower" (Dalmaris et al., 2005). Therefore, it is assumed that knowledge can be codified, formatted and stored for retrieval at a later time. The cognitive perspective, as this has come to be known, is the idea of human perception, cognition and structures of knowledge (Belkin, 1990). Knowledge is seen as being shaped by experience through interaction with the physical world and perceptions drawn from verified phenomena and analysis. As such knowledge can be subjected to criticism (Popper, 1972). The quality of knowledge does not relate to its host or container, but to the degree by which it has been tested and verified (Dalmaris et al., 2005). According to this view, knowledge does not refer to "beliefs" (justified or not) but to claims about the world that can be tested- a position contrary to the community/social perspective of knowledge. The social perspective posits that knowledge is developed in social interaction with other people (Berger and Luckmann, 1966). It develops from experiences, beliefs, culture and social influences. According to this perspective, a person's knowledge is dependent on the social context where that person belongs and is

perhaps rooted in post-modern thinking of social constructionism which argues that it is through the daily interactions of people in the course of social life that people's versions of knowledge become fabricated. An important facet of social construction is language use, culture and historical context within which the knowledge has been created. Therefore knowledge can be viewed as a "negotiated" understanding of a phenomenon which could take a variety of different forms from community to community and we can talk of numerous "social constructions" of the same phenomenon (Burr, 1995).

It is noticeable that the conceptualisations of knowledge influence the approaches to KM in organisations; however these are often fragmented and incomplete (much like the views of knowledge) with the effect of inhibiting genuine knowledge from being developed and leveraged. We propose that a pragmatic conceptualisation of knowledge is required in order to answer two important questions: what constitutes knowledge within the context of organisational settings; and how is this knowledge identified? It is posited that a pragmatic approach to defining knowledge should identify the knowledge which is useful to an organisation. Therefore, a conceptualisation of knowledge as the know-how and know-what that drives an organisation's processes might be seen as a starting point towards identifying the knowledge management approach that best leverages an organisation's knowledge assets. The operations perspective put forward here is: knowledge is that which enables organisations to run the processes that transform inputs into finished goods and/or services; the smooth running of processes that transform inputs is dependent on the knowledge possessed by the employees tasked to complete the processes; that knowledge is continuously adapting to internal forces such as improvement drives or external forces such as demand shifts and market trends. What is produced during this evolutionary process is the know-how, the know-what and know-why of service or product delivery; essentially the knowledge that drives an organisation. Each activity is tied to a desired outcome; the "in order to" knowledge (Heidegger, 1962). Coupled with the skill and the experience to carry out the activity, it can be argued that an organisation has the right knowledge to complete its value-adding activities. We therefore define knowledge as the know-what, know-why and know-how to manage organisational processes and procedures in the facilitation of input transformation to produce goods and/or services and is embodied in the successful execution of processes, routines, directives and organisational practices that help to complete the transformation process. The nature of this knowledge is constantly being enhanced as employees interact with the processes they manage. New knowledge is created, old knowledge is archived and there is a perpetual interplay between the tacit and explicit dimension of knowledge; the generative dance (Cook and Brown, 1999). A benefit of the operations perspective is that knowledge that contributes to value–creating activities can be linked to business processes by isolating a process in order to identify the people, knowledge, mechanisms, and equipment that are associated with that process. Furthermore, a flow of data, information and knowledge can be mapped; in effect linking process to process and identifying events such as bottlenecks, failures and inefficiencies in the whole system. Identification of such inefficiencies is relevant to KM because it becomes the trigger for knowledge creation. A direct consequence of this is that the knowledge produced by analysis of processes is not abstract but context relevant, and can be readily applied to real situations that arise in organisations on a day-to-day basis. For example, two engineers could make two different decisions based on the same process output data. The differences in analysis could be attributed to differences in experiences and/or analytical knowledge. The experiential dimension of knowledge is largely emphasised by the community/social approach. However, this dimension of knowledge is just as important for the execution of organisational processes as the explicit knowledge i.e. the process data about which decisions need to be made. Further to this, satisfactory execution of

the decision made is highly dependent on the skill of the engineer tasked to the do the job. Therefore based on the outcome of work carried out, it can be concluded that an engineer has the knowledge (know-how or skill) to maintain manufacturing equipment or not; much like one could critique the surgical skills of a surgeon. In each of these cases, knowledge (or lack thereof) is judged by the outcome of the process/ procedure. As such it is concluded that there exists reciprocity between the cognitive and community approaches to knowledge and that the operations perspective considers this relationship without emphasis on either of them. The operations perspective encapsulates the cognitive/community perspectives of KM initiatives identified earlier which suggests that they are both correct but partial views of reality and that the operations perspective provides the holistic perspective KM requires. This is illustrated by figure 1 below. Likewise, the operations perspective of KM is concerned with the identification, development, retention, sharing and accessibility of process-related knowledge as when and when it is required; i.e. just in time for application on a transformation process.

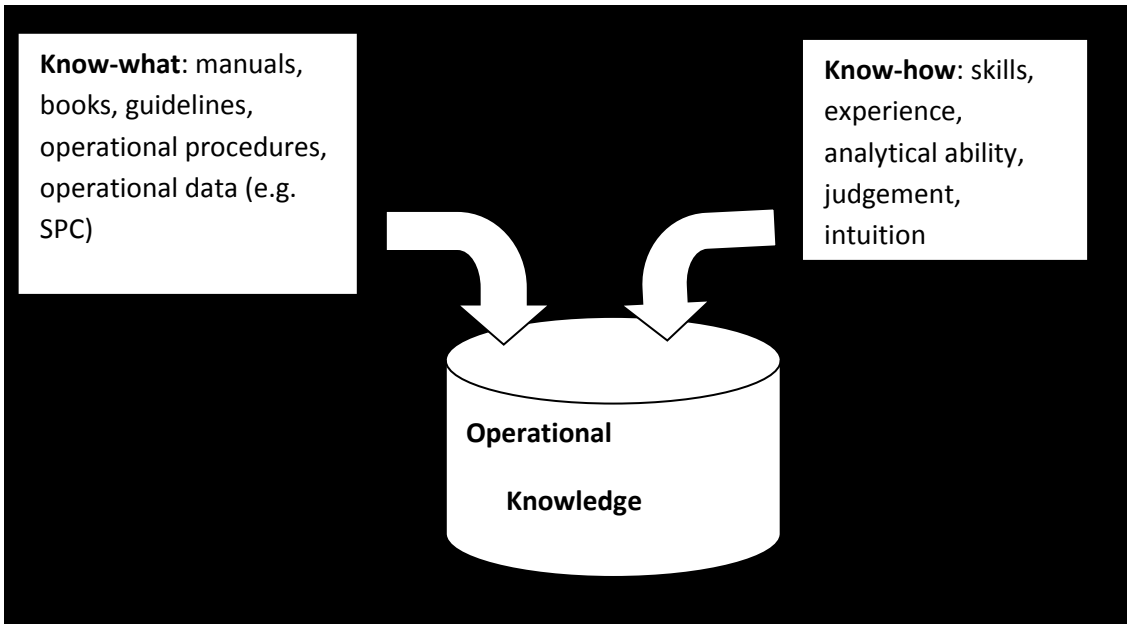

Figure 1: Illustrating an Operations perspective of knowledge

In the final analysis, the operations perspective of knowledge and KM is not a prescriptive solution to the KM problem. It is a perspective that takes a considered approach to the manner in which task/process knowledge is managed based on the context of its use in the organisation. Therefore when considering the suitability of KM mechanisms, emphasis is placed on their applicability to an organisation's processes, and the situational analysis of the organisation. The following section discusses the concept and process of KM assessment.

3. The Assessment of KM systems

The systematic analysis of an organisation's current KM capability is known as KM assessment. KM assessment is intended to evaluate the necessity of KM solutions, the knowledge these solutions can help to discover, capture, share, or apply along with the influence they can have on individual or organisational performance. Accordingly, a KM assessment can help establish the baseline for implementing those KM solutions including the

existing infrastructure and technologies that can help support those efforts (Becerra-Fernandez et al., 2004). At this juncture, it is important to review and understand the theoretical underpinnings of KM assessment in order to locate the value of our contribution. The contingency perspective proposed by Becerra- Fernandez and Sabherwal (2001) applied the SECI model (see Nonaka, 1994; Nonaka and Takeuchi, (1995) in order to demonstrate that the effectiveness of a knowledge management process is influenced by the particular context in which the knowledge is being used. In other words, instead of following the universalistic view that all four knowledge management processes (socialisation, externalisation, combination, internalisation) are always effective, they suggested that the impact of knowledge management is moderated by the context in which the knowledge is being used- namely the nature of the tasks. Essentially, Becerra-Fernandez and Sabherwal argued that the implementation of KM processes that suit the tasks performed by the unit will provide more knowledge management satisfaction than implementation of those that do not. They characterised tasks as content-oriented tasks and process-oriented tasks; the former focusing on the specific ends or goals to be achieved and hence relying upon know-what or declarative knowledge while the latter focuses on the processes or means that should be used to attain goals and hence rely on know-how or procedural knowledge.

An alternative theory that underpins KM assessment is the organisational capabilities perspective proposed by Gold et al., (2001). They argued that the key to understanding the success and failure of knowledge management within organisations is the identification and assessment of the preconditions that are necessary for the effort to flourish. The preconditions are broadly described as "capabilities" or "resources". These capabilities are divided into infrastructure capabilities and process capabilities. Infrastructure capabilities include technology, structure and culture. Since technology is multi-faceted, the organisation must invest in a comprehensive infrastructure that supports the various types of knowledge and communication that are critical. The technological dimensions that are part of effective knowledge management including business intelligence, collaborations, distributed learning, knowledge discovery, knowledge mapping, opportunity generation as well as security (Gold et al, 2001, p. 187-188). Organisational structure is important in leveraging technological architecture. Structural elements have often had the unintended consequences of inhibiting collaboration and sharing of knowledge across internal organisational boundaries (*ibid*). Hence structure provides the relationship context. Culture provides the shared context in the organisation (Lindsey, 2002). Accordingly, employee interaction should be encouraged, both formally and informally, so that relationships, contacts, and perspectives are shared by those not working side by side. This type of interaction and collaboration is necessary when attempting to transmit tacit knowledge between individuals or convert tacit knowledge into explicit knowledge (Nonaka, 1994; Nonaka and Takeuchi, 1995). Process capabilities are similar to the knowledge management processes that have been put forward by various authors. Most studies include the following knowledge management activities/ processes: creation, use, exploitation, capture, transfer, acquisition (Delong 1997; Spender and Grant, 1996). We discuss the significance of these KM processes in the context of assessment below.

The two theories presented above emphasise different aspects of the organisation as the focus of the assessment exercise although both seek to establish the effectiveness of KM process.

The contingency theory emphasises a focus on task characteristics and how these are aligned to the KM processes used by the organisation while the capabilities perspective is essentially a framework of KM processes and organisational infrastructure which is supposed to represent the organisational KM blueprint. Although Gold et al, (2001) did not sufficiently define the concept of effectiveness, they stated that effective knowledge management through the development of capabilities should contribute to key aspects of organisational performance. For instance, the organisation should experience a learning effect in which it improves in its capabilities for creating value. Similarly, KM effectiveness may result in improved ability to innovate, improved coordination efforts and rapid commercialisation of new products or other traditional indicators of knowledge contribution in terms of bottom line figures such as return on investment (ROI) and return on equity (ROE)(Ahmed et al, 1999).The concept of KM assessment can therefore be viewed through a couple of related lenses: firstly, the assessment of an organisation's KM capability or the suitability of the KM processes for task characteristics; and secondly the assessment of the overall effectiveness of the KM processes on the organisation's performance. It follows that one would expect a positive overall impact on organisational performance as a result of a clear alignment between KM processes and task characteristics being established. While the two theories discussed above give guidance on the former, there is no guidance on the actual assessment process or tools that can be used for this task. Their key contribution goes as far as identifying the various elements of the KM architecture to be considered when assessing the effectiveness of KM processes in the organisation. This includes the KM processes/activities that are expected to be practiced in an organisation for the effective management of knowledge. It has to be understood that these KM processes are a compilation of KM activities available to organisations and that the choice to practise any of them should be guided by the relationships between KM processes and task characteristics (Becerra-Fernandez and Sabherwal, 2001). We identified some KM processes above: creation, use, exploitation, capture, transfer, acquisition (Delong 1997; Spender and Grant, 1996). Furthermore, Gold et al. (2001) proposed the following as the key KM processes: acquisition, protection, conversion and application. Clearly there is considerable consensus in the literature on the KM processes/activities. We submit a comprehensive list of KM processes compiled from a review of literature and instantiated by a pilot study as follows: identification, development, creation, sharing, access, retention, integration. We propose that the KM processes/activities serve as a foundation for the KM assessment exercise. Each organisation can systematically assess each of the processes and determine its performance in each individual category and develop an improvement plan which can be localised or more broad-ranging within the organisation. The proposed assessment process also clearly defines the relationship between task characteristics and KM processes and goes further to define the concept of KM effectiveness from the operations perspective. Meanwhile, it is important to put the foregoing discussion in the context of the operations perspective. KM assessment should determine the effectiveness of the KM processes and practices of an organisation in relation to the organisational processes and day-to-day activities. Thus KM processes and practices of an organisation need to reflect the organisational processes which they support in order for them to be considered effective. The operations perspective takes the view that KM effectiveness can be predicated by the ease with which task/process knowledge is identified,

created, developed, shared, integrated, retained and accessed in time for it to be applied to organisational processes; that is, knowledge as and when it is required. Therefore KM effectiveness is operationalised and determined by the availability of knowledge at the right time and place for application to organisational processes. In order to achieve this end, organisations need to undergo a KM assessment process that determines the following:

- Establish KM requirements
- Determine effectiveness of KM processes for organisational processes
- Identify areas for KM improvements
- Implement KM improvements

The next section applies the identified KM assessment stages in order to critique KM assessments tools identified in the KM literature.

3.1 KM Assessment tools

Space precludes the full description of all the KM assessment tools that were found in the extant KM literature although two distinct categories were noted: pictorial or illustrative tools and non-illustrative tools. Of the non-illustrative tools, there are a few notable examples from consultancy companies that offer KM solutions. A common feature of these tools is that they are questionnaires that enable organisations to rate their performances in a number of KM categories using various scales, typically 1-5. Another feature is that they assess the knowledge orientation of an organisation and how advanced an organisation is in understanding and implementing knowledge management. The questionnaires are designed for building a KM profile for organisations; they do not determine the effectiveness of the KM profile. A major weakness of these assessment tools is that they do not elaborate how the results should be interpreted. For example, the KM assessment tool and model (European KM forum, 2002) is a survey-based illustrative tool which merits discussion because of its breadth and potential in generating valuable KM-related knowledge about an organisation. The KM assessment is structured into the following sections: general section; KM strategies; human and social KM issues; KM organisation; KM processes; KM technologies; KM leadership; KM performance measurement and KM implementation; business areas. Associated with these major sections are open questions, closed questions, indicators and rating scales. The most noticeable aspect of the KM assessment questionnaire is its breadth. It covers a wide spectrum of KM activities: structural, cultural and technological enablers as well as organisational elements that are affected by KM from financial to process. It is therefore difficult to narrow the functionality of the model to a specific organisational hierarchical level i.e. strategic, tactical or operational. The constructs seem to be interwoven-perhaps a result of the amalgamation of existing KM assessment models and tools. While breadth may be considered to be a strength of the tool, it makes it difficult to assess particular aspects of KM in any amount of detail because of the variety of analytical methods that will need to be employed in order to extract meaning out of the output. For example, some parts of the questionnaire require answers that are limited to a yes/no, while some require description of process; still, others require some form of rating on a 1 to 5 or sometimes -2 to 2 scale. Clearly the analysis and presentation of such an exercise could be cumbersome. However, the

biggest failing of the tools is that they provide very little guidance to the organisation on how to determine which KM activities/process they need to focus on or how to improve those that are found to need development or improvement. KM assessment profiles need to be associated with other elements such as KM requirements, effectiveness, and improvements as concluded in the previous section in order to be regarded as complete.

Illustrative tools have also been used in KM assessment to visually represent aspects of an organisation's KM profile. For example, the radar diagram was used to "measure" knowledge management in Malaysian organisations (Tasmin and Woods, 2008). The study measured five knowledge management practices: leadership, culture, technology, process, and measurement; arguing that this proposition encapsulated the overall "best practices." Their results showed that the level of KM practices among Malaysian large manufacturing firms was at a moderate range; measured at an overall mean value of 3.06 using a scale from 1 to 5. The description of the 1 to 5 scale was not reported. Likewise, Burnett et al (2004) used the radar diagram in order to show working practice within the tax department of a multinational oil exploration and production company. The radar diagram was used to represent the current level of KM activity, both for individuals and the department. Six KM criteria were chosen for measurement: acquisition and learning, dissemination and transfer, storage and maintenance, application and exploitation, knowledge creation, and performance measurement. The study used a scale that showed performance levels from 1 to 6. Both studies are similar to the survey type assessment of organisational KM which does not go beyond providing a KM profile for an organisation. A major weakness with such studies is that they measure and illustrate "aggregate" variables, for example, technology, acquisition and learning, and transferability. Although these constructs are informed by a set of questionnaires in the study, the output cannot illustrate how the elements of the questionnaires contribute individually; they can only provide an illustration for the whole. In the context of this research, this is considered as a weakness. The KM assessment tool, while providing an aggregate picture of the organisational KM profile, also needs to show the individual relationships between KM processes/activities and the KM mechanisms in a manner that lends the relationships to scrupulous evaluation. For example, if one was to consider the KM process of knowledge sharing, various mechanisms could be used by an organisation including e-mail, coaching, workshops, discussion boards, etc. An organisation might score very well in this KM process but would not be able to illustrate which of the KM mechanisms is the most or least effective using a radar diagram because the tool does not permit such analysis. This level of detail is essential for a KM assessment exercise as it identifies granular elements that could contribute towards improvements to the KM practices of an organisation and/or those that constitute wasted resources. Furthermore, KM mechanisms can be applicable to more than one KM process; for example mentoring can be used as a knowledge retention mechanism as well as knowledge sharing. This gives rise to the concept of primary and secondary uses of KM mechanisms where the primary use of a KM mechanism is in its intended KM process and secondary uses apply to any other KM processes to which it is applicable. These relationships cannot be illustrated using the radar assessment tool and an alternative needs to be considered. A second notable weakness in the use of radar diagrams is the difficulty of using the output to identify key areas for KM

improvements. In their study, Burnett et al (2004) attempted to use the comparisons made between individual and departmental performances for this purpose. However, an underlying assumption of their study was that the KM mechanisms used for each of the knowledge management processes being measured were appropriate- hence more use of the KM mechanisms would directly constitute more KM effectiveness. We consider this argument to be flawed as there is insufficient evidence from the tool that suggests that the KM processes were appropriate for the organisational processes and were hence effective. We recognise that each KM process that an organisation undertakes needs to be aligned to the operational objectives of the organisation and task characteristics. Moreover, KM processes should focus on value-creating (or core business) activities only. KM initiatives that attempt to manage all knowledge within the organisation have been shown to fail when overwhelmed by a large amount of knowledge (Remus and Schub, 2003). Hence identifying value-creating processes and the associated knowledge assets should be a major part of a KM assessment exercise. It needs to be emphasised that the task characteristics of value-creating processes in the organisation should determine the level of importance assigned to each KM process adopted to manage the associated knowledge; this has got to be captured and reflected by the KM assessment tool and subsequently used for any decision-making about KM improvements.

Ahmed et al, (1999) proposed a measurement matrix whose use went a considerable way to address some weaknesses noted in the radar diagram. They argued that the matrix helps in obtaining a deeper understanding of how KM affects the organisation as a whole and it also prompts practitioners to look at the various aspects of implementing KM. "*It forces the practitioner to consider all factors, "soft" as well as "hard" factors and it also forces managers to link KM to the overall organisation's policy and strategy*" (Ahmed et al, 1999 p. 309). The measurement matrix combines the COST (customers, organisation, suppliers, technology) model and the four steps for KM. The COST model represents the key areas to which an organisation must direct attention so as to capture all aspects for effective knowledge management. On the other hand, the four steps of KM, which were not explicitly defined by Ahmed and his colleagues, are knowledge capture, share, measuring and learning. These are taken to represent the KM processes which were discussed above. The proposal by Ahmed et al (1999) did not provide a scale of measurement, neither was there a practical application of the matrix in order to test its value. However, it was observed that the use of a matrix could overcome the major weakness identified when appraising the radar diagram tool- its inability to illustrate individual relationships between KM processes and mechanisms. The matrix could be used to show the individual relationships between KM processes and KM mechanisms and goes further to illustrate the primary and secondary uses of KM mechanisms where KM mechanisms are applicable to two or more KM processes. It is therefore capable of providing an aggregate as well as a partial view of the KM reality in an organisation. The measurement matrix as proposed by Ahmed et al (1999) had a couple of notable weaknesses: firstly, it did not propose a method of analysis which manipulates the measurement matrix output into descriptive and evaluative accounts/reports of an organisation's KM system. This is the first step towards the development of performance benchmarks; establishing KM effectiveness in the organisation; a basis for comparison of KM practices between different organisations, and the improvement of KM practices. Secondly, the measurement matrix does not capture "contextual" issues within an organisation. The framework proposed by Gold et al (2001) refers to structural and cultural issues that affect the implementation of KM practices in organisations. These "contextual"

reflect the peculiarities of an organisation's internal environment. We posit that a matrix can accommodate the addition of this dimension better than any of the tools reviewed in this section. The following section introduces our KM assessment tool and methodology. It represents a descriptive and illustrative tool that meets the assessment requirements as outlined in this section while demonstrating how to address the weakness observed in other KM assessment tools.

4. The KM assessment tool

The KM assessment tool we propose in this section is an adapted version of the Quality Function Deployment tool which makes extensive use of matrices. Traditionally, QFD is used for the development of specifications for products in manufacturing industries. The QFD matrix (also referred to as the House of Quality) is a formal articulation of how an organisation sees the relationship between the requirements of the customer (*the whats*) and the design characteristics of the new product (*the hows*) (Slack et al, 2004).The common element in all of the applications of QFD is that the final product needs to reflect the customer requirements in quality to the point of delighting them (Kano, 1984). Essentially, the QFD matrix is able to show the relationship between results and causes or between objectives and methods when each of these consists of two or more elements or factors (Asaka and Ozeki, 1988). This concept has been transferred to various other industries including health, education and government. For example, Helpler and Mazur (2008) used it for concept innovation and strategic decision-making in health; Hines (2008) used it for understanding, prioritizing, and developing solutions to address future needs of customers; and Haraga (2007) used it for effective business design. The variety of the applications of QFD is evidence that the tool is adaptable and could be modified to meet the requirements of a KM assessment tool as outlined in section 3. Asaka and Ozeki (1988) observed that when various symbols are used to indicate the presence and degree of strength of a relationship between two sets of essential items the following benefits can be realised:

i) The use of symbols makes it visually clear whether or not a problem is localised or more broad ranging
ii) It is possible to show the problem as a whole, and view all the various relationships between the various elements at once
iii) By testing and evaluating each relationship intersection of the essential factors it becomes easier to discuss the problem at finer levels of detail
iv) It is possible to look at specific combinations, determine essential factors and develop an effective strategy for solving the problem

Clearly the value of the QFD matrix as a basis for the KM assessment tool is undeniable. Its main value lies in its ability to illustrate various relationships, a feature that is invaluable in depicting the KM reality of an organisation. Furthermore, QFD employs mathematical analysis using a series of matrices which depend on functional relationships to arrive at the highest level of quality in product. Various types of graphs and charts are automatically prepared for aiding in analysis of the matrix. We observed that one of the weaknesses of the KM assessment tools we reviewed was that they did not have clear methods or processes for analysis and interpretation of the output. As noted earlier, this aspect of the KM assessment process is critical as it forms the foundation for KM improvements in the organisation. Based on the foregoing arguments, the QFD tool and methodology was considered a robust option to inform the design of the KM assessment tool.

The KM assessment tool has three key sections: the KM processes, KM mechanisms and KM barriers. The KM processes are listed as knowledge identification, creation, development, sharing, retention, access, and integration. KM mechanisms are a compilation of practices and tools that organisations use to manage knowledge. They were compiled from a literature search, predominantly from large-scale surveys for example OECD (2001) and KPMG (2003) and supported by a pilot study. KM mechanisms can be technological or community-based, thus embracing the capabilities framework submitted by Gold et al., (2001) and supported by our operations perspective of KM. KM barriers are an important dimension of KM assessment because they highlight some of the structural and cultural elements of an organisation that have an adverse effect on the implementation or improvement of KM practices. Typically, lack of supporting infrastructure and lack of IT skills are recurring KM barriers in organisations (OECD, 2001); Handzic, (2003). Likewise, knowledge hoarding and fear of idea robbery are common cultural barriers to KM. A small but highly significant aspect of the KM assessment tool is the column which allows organisations to rate the relative importance of each of the KM processes from the organisation's perspective. This dimension is very important to the KM assessment because it reflects the priorities of an organisation with respect to KM processes. The rating of relative importance to organisation is moderated by process and task characterisations within the organisation. Organisations should use contextual information about their operations, tasks, knowledge types and knowledge flows in order to assign importance scores to these knowledge management processes. For example, it is expected that knowledge creation would receive high importance scores in organisations where product life cycles are short and there is a requirement to continually bring new products to the market in order to remain competitive. This would differ quite significantly from an organisation that is production-oriented and the changes to the product range and design are few and incremental. The "roof" of the KM assessment tool represents the inter-relationships between the KM mechanisms. The cells in the "roof" are used to identify where the KM mechanisms support or impede each other. For each of the cells in the roof the following possibilities exit:

- Improving one KM mechanism causes the other to improve (synergy)
- Improving one KM mechanism causes the other to deteriorate (compromise)
- There is no perceived relationship between the two KM mechanisms.

The KM mechanisms assessment dimension of the KM assessment tool is similar to the technical data assessment dimension in traditional QFDs. It calculates the overall and relative effectiveness of each mechanism to an organisation. The scores are calculated based on the strengths of the relationship between a mechanism and each of the KM categories and are subsequently summed up in order to show the overall effectiveness of a mechanism in the organisation. The analysis that is used in the KM assessment tool is borrowed from the QFD methodology. The KM assessment matrix is illustrated in the Appendix.

4.1 The KM assessment process

In the first stage of the KM assessment process, it is essential to identify the knowledge types, level of standardisation of tasks and the number of interacting units associated with the value-creating processes of an organisation. This information is essential in deciding the importance of the KM processes used to manage the process knowledge. The assessing team should then use this information to assign importance ratings for each of the seven KM processes on the KM matrix. Importance ratings may also be assigned to KM processes where an organisation may already be aware of problems or deficiencies. For example, knowledge retention may be

assigned a very high importance rating in an organisation that experiences a high employee turnover rate. Importance ratings range from 1-5, similar to those used in QFD. The second stage is a cumbersome activity which involves rating the individual relationships between KM processes and KM mechanisms. Each cell which is an intersection between KM process and mechanism represents a rating for the effectiveness of the KM mechanism. On the KM assessment matrix, the main section illustrates the relationships between KM processes and mechanisms. An empty cell would mean that the KM mechanism is not used for the KM process in the organisation therefore an effectiveness rating for that relationship is inapplicable. Likewise, each cell which is an intersection between KM processes and KM barriers represents the perceived impact of the KM barrier on the knowledge process. The relationships between KM processes and KM mechanisms are weighted using a commonly used 9-3-1 scale. This scale is the same one applied to the relationships between KM processes and barriers.

Once each of the sections has been filled, the KM assessment matrix is analysed using methods employed by the QFD methodology meaning that each KM mechanism is assessed individually and as part of the whole KM system. Organisations can determine the alignment of their KM requirements and effective KM mechanisms at this point. For example, it will now be possible to determine whether the KM mechanisms rated as the most effective in the organisation have direct relationships with KM processes that are considered important to the organisation. The use of symbols also makes it possible to visually locate weak KM processes in the organisation just by considering the patterns of relationships on the KM assessment matrix. It is possible at this stage to ask questions such as: why does the organisation not use process mapping when it seems relevant for the type of work we do? Further analysis of the KM system can be conducted as the organisation seeks to determine whether the KM mechanisms rated as most effective in the organisation are appropriate when their task characteristics and other organisational elements are considered. This is the initial link between organisational operations and KM mechanisms effectiveness. Up to this point of the assessment, the organisation is still not fully aware of the extent to which its KM practices are effective (or not) for the organisation's operations therefore any improvement plans maybe incomplete. It is proposed that organisation could use the KM assessment matrix to configure a KM system that would be "desirable" for their organisation. This task requires the population of a second KM assessment matrix. It is averred that the juxtaposition of this "desirable" KM system with the "current" system more clearly highlights the shortcomings and weaknesses of the current system and provides the assessment team with an opportunity to appreciate the size of the task of making KM improvements. At this point the KM assessment process is complete and the next stage is to chart a path for the organisation to migrate from its current state towards a desired state.

5. Discussion and Conclusion

The use of the 9-3-1 scale is common in QFD applications, for example, Zairi (1992); Chan et al (2006); Slack et al (2004); Maji (2006). It is a widely accepted standard for the main "section" of the matrix which pairs the *"whats"* with the *"hows"*. The 9-3-1 scale was adopted for the KM assessment tool primarily on the merits of its wide acceptance in QFD literature. Notwithstanding this position, it is noted that the use of scales in research impacts on the robustness of findings (Van der Ven and Ferry, 1980). In particular, the inferred meaning of the 9-3-1 scale is that the difference between strong, medium and weak weightings is a factor of 3. This in itself could become problematic especially since the

measure of effectiveness is determined by the perception of users and management and hence subjective. Therefore it is likely that "intermediate" weightings are lost in the gap between these options. Van der Ven and Ferry (1980) also argued that when assigning scales for assessment, the options for respondent answers should be optimal to reflect the differences in the variables being measured -too few options may result in the disparity in the scale too big while too many also make the difference too fine to detect or interpret the differences in the measures. Notwithstanding, the 9-3-1 scale was deemed appropriate on the strength of its widespread use in QFD; to be reconsidered in the event of problems arising in the application of the KM assessment tool. Apart from the scaling concerns, the KM assessment tool proposed in this paper meets and exceeds the requirements outlined for a complete assessment process. We go further to argue that the KM assessment tool can be employed by new organisations that do not have existing KM systems for the purposes of defining KM requirements and designing a KM system. The strength of the proposed tool and methodology is that it is not prescriptive on what needs to be part of an organisation's KM architecture. Its strength is that it promotes debate and dialogue on the use (or lack thereof) of available knowledge resources and mechanisms. Therefore the list of KM mechanisms should not be considered to be complete. It is acknowledged that KM mechanisms will vary from industry to industry and also evolve over time.

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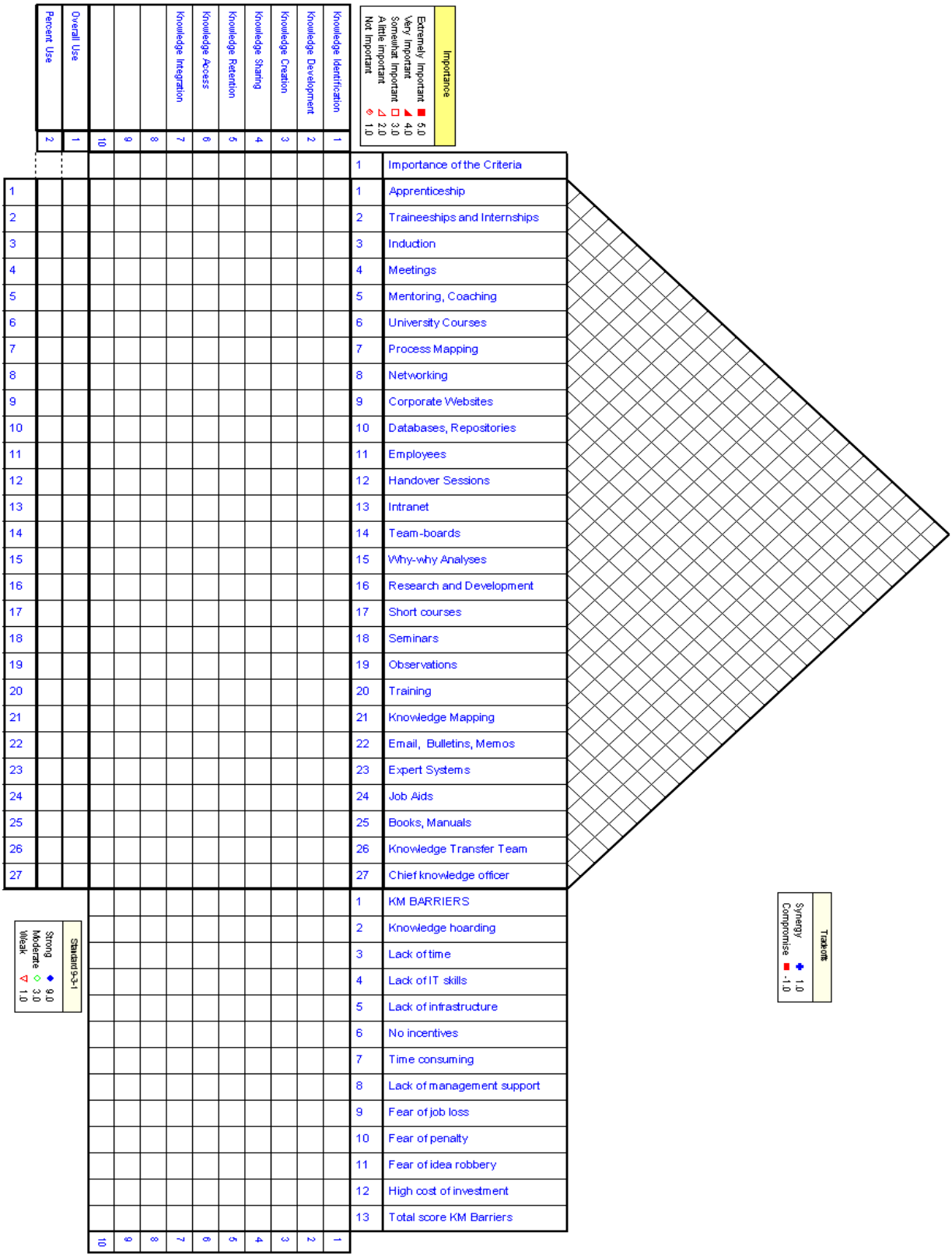
Appendix


Appendix 1
Importance
Extremely Important 5.0
Very Important 4.0
Somewhat Important 3.0
A little important 2.0
Not important 1.0
Knowledge Identification
Knowledge Development
Knowledge Creation
Knowledge Sharing
Knowledge Retention
Knowledge Access
Knowledge Integration
Overall Use
Percent Use
1 Importance of the Criteria
1 Apprenticeship
2 Traineeships and Internships
3 Induction
4 Meetings
5 Mentoring, Coaching
6 University Courses
7 Process Mapping
8 Networking
9 Corporate Websites
10 Databases, Repositories
11 Employees
12 Handover Sessions
13 Intranet
14 Team-boards
15 Why-why Analyses
16 Research and Development
17 Short courses
18 Seminars
19 Observations
20 Training
21 Knowledge Mapping
22 Email, Bulletins, Memos
23 Expert Systems
24 Job Aids
25 Books, Manuals
26 Knowledge Transfer Team
27 Chief knowledge officer
1 KM BARRIERS
2 Knowledge hoarding
3 Lack of time
4 Lack of IT skills
5 Lack of infrastructure
6 No incentives
7 Time consuming
8 Lack of management support
9 Fear of job loss
10 Fear of penalty
11 Fear of idea robbery
12 High cost of investment
13 Total score KM Barriers
Standard 9-3-1
Strong 9.0
Moderate 3.0
Weak 1.0
Tradeoffs
Synergy 1.0
Compromise -1.0