DEVELOPMENT OF A MEASURE FOR KNOWLEDGE MANAGEMENT: AN EMPIRICAL TEST AND VALIDATION OF THE KNOWLEDGE MANAGEMENT ORIENTATION CONSTRUCT

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Abstract

In spite of abundant literature on knowledge management the intricacy of knowledge management performance remains relatively under researched. Current understandings of knowledge management performance are either wholly conceptual or case anecdotes. There is a severe paucity in empirical evidence, and what evidence exists is largely of a descriptive nature. The lack of effective knowledge management measurement constructs is a key reason for the lack of empiricism in the field. This lack hinders both corporate practice as well as academic research into the role of knowledge management in yielding performance outcomes. Through extensive literature review this paper adopts a capability-based view to develop a construct, named knowledge management orientation. The construct consists of five components, namely the knowledge system, organisational memory, knowledge sharing, a learning culture and knowledge benchmarking. The construct is tested using confirmatory factor analysis performed in AMOS 4.0. The construct validity and reliability are reported in this paper. Theoretical and methodological issues for adoption of the knowledge management orientation construct are discussed.

Keywords: Knowledge management orientation, capability, confirmatory factor analysis.

Development of a Measure for Knowledge Management: An Empirical Test and Validation of the Knowledge Management Orientation Construct

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Abstract

In spite of abundant literature on knowledge management the intricacy of knowledge management performance remains relatively under researched. Current understandings of knowledge management performance are either wholly conceptual or case anecdotes. There is a severe paucity in empirical evidence, and what evidence exists is largely of a descriptive nature. The lack of effective knowledge management measurement constructs is a key reason for the lack of empiricism in the field. This lack hinders both corporate practice as well as academic research into the role of knowledge management in yielding performance outcomes. Through extensive literature review this paper adopts a capability-based view to develop a construct, named knowledge management orientation. The construct consists of five components, namely the knowledge system, organisational memory, knowledge sharing, a learning culture and knowledge benchmarking. The construct is tested using confirmatory factor analysis performed in AMOS 4.0. The construct validity and reliability are reported in this paper. Theoretical and methodological issues for adoption of the knowledge management orientation construct are discussed.

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1. Introduction

Research into knowledge management has generated a diverse variety of literature, covering definitions of knowledge and knowledge management, knowledge management processes, approaches, contingencies, contexts, and critical success factors of knowledge management programs etc. In spite of a few recent attempts, the intricacy of knowledge management performance remains under researched. Indeed there is a great deal of confusion in the field due to the fact that numerous frameworks have been descriptively proposed which contain superficial and/or artificial differences. A good example of this is noted by Bontis (2001) in the field of knowledge management and intellectual capital performance measurement models. Firstly, major models place emphasis on intellectual capital and segregate knowledge into several artificial categories. Secondly, many models have similar constructs and measures that are merely labelled differently. For example, the human capital (Skandia Navigator) is also called human-centred assets (Technology Brokers) and competence of personnel (Intangible Asset Monitor). Thirdly, most of the existing models are case-based, which are primarily of anecdotal nature. The position is atypical of the spectrum of research in knowledge management. Little research has been done in a manner that facilitates generalised findings. This calls for an effective measure of knowledge management, such that it can be adopted to identify its impact on performance. The lack of such measures also hinders corporate knowledge management practices. Pragmatically, some companies assess knowledge management outcomes at project-based levels, i.e. to calculate the ratio of input and output of a single knowledge management program. This essentially neglects the wider impact of knowledge management on organisational capabilities, which consequently lead to performance. Other companies claim that they adopt a long-term strategic view, holding a faith that knowledge management will contribute to organisational performance outcomes in the long-term, in which case short-term outcomes are not measured.

Recent research by Darroch and McNaughton (2001) developed a knowledge management orientation construct, which has helped to move the field a step forward. However, their construct is heavily rounded in Kohli et al’s (1993) market orientation scale. They defined knowledge management orientation analogous to market orientation and containing three components: knowledge acquisition, knowledge dissemination and responsiveness to knowledge. In this conceptualisation market orientation is regarded as a subset of knowledge management orientation. Although these two concepts overlap, market orientation and knowledge management orientation have different emphasis. For example, market orientation captures behaviours of firms oriented toward the marketplace (Jaworski et al 2000) and therefore externally oriented (Day, 1994). A firm could be market-oriented, but not necessarily emphasise knowledge about non-market factors. Whereas, another firm could be knowledge management oriented but not possess knowledge about the market. This indicates a need for the development of an independent knowledge management construct, which is the task of this paper, such that its content domain is distinct from other organisational constructs. This would facilitate rigorous testing of casual relationships and thereby provide greater understanding of the relationship between the various aspects of organisational capabilities to performance. This paper defines knowledge management as an organisation's distinctive capability, and through extensive literature review identifies five aspects underlying this capability, namely the knowledge system, organisational memory, knowledge sharing, a learning culture, and knowledge benchmarking. Knowledge management orientation depicts an organisation's overall capability demonstrated in these five dimensions. Confirmatory factor analysis was used to test the construct validity. First and second-order confirmatory factor analysis, as well as construct validity and reliability are reported in this paper. Theoretical and methodological implications are also discussed.

2. Knowledge Management Orientation

Most research papers have lengthy elaborations on definitions of knowledge. Two prime categories of knowledge are widely discussed, i.e. tacit (codified) knowledge and explicit (uncodified) knowledge. It is also generally agreed that managing knowledge is not only about information technology, but also managing people and processes. The majority of knowledge management definitions in the extant literature are process-based. To summarise the process-based views, *knowledge management is about managing both explicit and tacit knowledge and using information technology to facilitate the processes of knowledge identification, acquisition, codification, storage, retrieval, sharing, dissemination, and creation, etc.* The process-based view captures the basic motions largely supported by information technology, but overlooks the fundamentals that enable these processes. One of such fundamental factors is a learning culture, which has been addressed by authors such as Davenport et al (1998), O'Dell et al (1999) and Ahmed (2001), using either case-based evidence or theoretical insights.

From the above insights on knowledge management contingencies and contexts together with those of many other authors such as Gold et al (2001), Gupta and Govindarajan (2000) and McDermott and O'Dell (2001) emerge five key aspects of knowledge management. They are the knowledge system, organisational memory, knowledge sharing, a learning culture and knowledge benchmarking, which are further elaborated in the following sections. Departing from the process-based knowledge management studies, this paper postulates a capability-based view and adopts the terminology of 'knowledge management orientation'. *Knowledge management orientation (KMO) is an organisation's distinctive capability of effectively managing the knowledge system, organisational memory, knowledge sharing, a learning culture and knowledge benchmarking to achieve organisational goals.* The knowledge system facilitates knowledge management tools and techniques, and enhances the capability of memory and sharing. Organisational memory serves as a repository of knowledge, while knowledge sharing maintains 'openness' and promotes knowledge flow and growth. A learning culture is the fundamental factor underlying the successful operation of the knowledge system, organisational memory and knowledge sharing. Whilst knowledge benchmarking maintains an external focus of the organisation.

2.1 The knowledge system

The knowledge system is the tools and techniques, in particular information technology, that support knowledge management practices. The role of the knowledge system has been widely recognised (Hansen et al, 1999; Roberts, 2000; Gold et al, 2001). Organisations should possess the capability of utilising information technology to facilitate knowledge identification, capturing, codification, categorisation, retrieval, dissemination, as well as promotion of dialogues and communications. Broadly speaking, information technology can be seen as embodying two general capabilities: managing codified knowledge (Hansen et al., 1999) and creating knowledge networks (Bloodgood and Salisbury, 2001; Nonaka and Takeuchi, 1995).

2.2 Organisational memory

Walsh and Ungson (1991) were among the first few authors who systemically elaborated the concept of organisational memory. They emphasised two major shifts of organisational memory: from individual to group-based memory, and from object to process-based memory. They adopted the concept of organisational memory as knowledge learned from the past organisational experience that can be brought to bear on present decisions. Authors have since attempted to strengthen the concept, but mostly resulted in various answers to the question “where does memory exist in organisations?” Wexler (2002) summarises organisational memory literature into four models: the storage bin model (where to store OM), the narrative model (how to motivate, retrieve and use OM); the innovative model (when to use what information and/or experience to solve which problem); and the political resource model (who gains or loses power in the use of OM), each consisting of memory practice of human, structural and relational capital. Instead of replicating the locations of organisational memory, this paper distinguishes from these process-based views by examining organisational memory as an organisation’s capability of managing infinitely retrievable (Corbett, 2000; Anand et al 1998; Moorman and Miner, 1997), usable (Anand et al 1998), accurate (Weick, 1979; Gray, 2001) and relevant knowledge (Anand et al 1998, Gray, 2001). Organisational memory indicates an organisation’s capability to remember what worked and what failed and must ensure that useful lessons were captured, conserved, and can be readily retrieved when needed (Day, 1991). This ideal understanding of organizational memory offers the possibility of combining and optimising existing technical and social mechanisms (Ackerman, 1996).

2.3 Knowledge sharing

Knowledge sharing emphasises the concept of knowledge-in-motion: effective knowledge management requires a constant flow of knowledge, rather than a stock of it. Flow is what facilitates the connections between seekers of specific knowledge and the providers of needed knowledge (Holtshouse, 1998). Schulz (2001) defines knowledge flow as the aggregate volume of know-how and how information transmitted per unit of time, and captures the overall amount of know-how and information transmitted between subunits in all kinds of ways, including via telephone, email, regular mail, policy revisions, meetings, shared technologies, and reviews of prototypes. Knowledge flow is the way knowledge travels and grows within an organisation. It is more about the human elements than the technology that supports it.

Notions of knowledge sharing vary. Some understand knowledge sharing as transfer of skills and technology between organisational subunits (Gupta and Govindarajan, 1991) or transfer of best practices (Szulanski, 1996). Others understand knowledge sharing as a multistage process that might involve initiation, implementation, ramp-up and integration (Szulanski, 1996). This paper identifies three streams of knowledge sharing: workflow-based knowledge sharing, communities of practice (Lave and Wenger, 1991), and sharing by contributing to organisational memory (Levitt and March, 1988; Feldman and March, 1981).

2.4 A learning culture

As previously noted, technology itself does not deliver knowledge management, but inspires the vision of ‘a new world of leveraged knowledge’ (McDermott, 1999). Adoption of information technology must be coupled with knowledge-friendly organisational culture in order to deliver knowledge performance (McDermott, 1999; Roberts, 2000). A learning culture underpins the capability of managing knowledge systems and organisational memory, and promotes knowledge sharing. For instance, extracting and codifying individuals’ knowledge disconnects seekers from providers and significantly reduces a provider’s control over who has access to this knowledge. This creates a set of conditions that allow managers to increase their control over most employees, and explores the conditions under which codified knowledge is likely to reduce employee power (Gray, 2001). It is, therefore, not surprising that employees are sometimes resistant to contributing to knowledge repositories. Organisations need to adopt a learning culture that empowers employees to contribute in order to avoid risk of forfeiting competitive advantage. Similarly, knowledge flow also requires a work environment that nurtures and accelerates the sharing of knowledge.

On the conceptual side, there is a wide variety of depictions of learning cultures. For example, Davenport et al. (1998) emphasised that a ‘knowledge-friendly’ culture is one of the most important factors for a knowledge management project’s success, and one of the most difficult to create if it does not already exist. Popper and Lipshitz (1998) proposed a learning culture that includes five hierarchically arranged values: continuous learning, valid information, transparency, issue orientation, and accountability. However, constructs of a learning culture tested through empirical data are few. Most authors focus on the broad organisational culture. Incorporating insights from several authors, this paper identifies that a positive orientation towards knowledge (Davenport, et al, 1998), transparency (Popper and Lipshitz, 1998, issue orientation (Popper and Lipshitz, 1998; Kanter, 1989; McGill et al., 1993), and accountability (March and Olsen, 1976; Shaw and Perkins, 1992) are key elements that enable a learning culture.

2.5 Knowledge benchmarking

Knowledge benchmarking is here referred to as an organisation's capability of measuring an organisation's knowledge assets against other organisations in order to identify the knowledge gap(s), adopting knowledge management best practices, and consequently improve its capabilities of managing knowledge to attain sustainable competitive advantage in the marketplace. Knowledge benchmarking is to a large degree involved in inter-organisational learning. The primary incentive of inter-organisational knowledge sharing and learning is to exploit knowledge complementarity. This complementarity may arise from knowledge exploitation of economic scale, market entry, managing strategic uncertainty, managing costs and risks, and other tacit collusion (Kogut, 1988; Hennart, 1988). In inter-organisational learning, both knowledge-specific variables (i.e. tacitness and complexity), and partner-specific variables (i.e. prior experience, culture distance, and organisational distance) impact learning outcomes between partner companies (Simonin, 1999). Effective inter-organisational learning depends on firms' absorptive capacity, causal ambiguity, and the arduousness of the relationship between partner firms (Szulanski, 1996).

The above five elements of knowledge management, i.e. the knowledge system, organisational memory, knowledge sharing, a learning culture and knowledge benchmarking are integral and inter-twined components of the proposed knowledge management orientation construct. The knowledge system provides tools and techniques that facilitate knowledge capturing, codification, storage and retrieval etc. and thus is related to the capability of organisational memory. The knowledge system also promotes dialogues and communications, through which knowledge flows and knowledge sharing occurs. Additionally, the knowledge system functions in accessing external information and knowledge and facilitates knowledge benchmarking. Organisational memory varies in the degree to which it is dispersed, or shared, throughout the organisation (Moorman and Miner, 1997). Organisational memory is not always centrally stored, but distributed across different retention facilities (Walsh and Ungson, 1991). Therefore, organisational memory by its nature involves some degree of dispersion throughout the organisation. Knowledge sharing is critical to knowledge flow and growth over time, which in turn provides a better chance to enlarge and enhance organisational memory. Knowledge sharing also promotes a culture based on trust in which people feel more willing to contribute to the knowledge repository. Additionally, effective organisational memory and knowledge sharing require a learning culture, featured by transparency, issue orientation, accountability, rewards and incentives, etc. Knowledge benchmarking enables a systematic assessment of an organisation's knowledge management capability and identification of knowledge management gaps. Through learning from benchmarking partners and adopting knowledge management best practices, organisations can achieve a higher level of performance outcomes. Knowledge benchmarking is also associated to organisational memory because an effective organisational memory improves the absorptive capability, which in turn affects the organisation's ability to learn new knowledge. These five components are summarised and a total of 30 key variables are included in Appendix 1. Following the above discussions, three hypotheses regarding the knowledge management construct are generated:-

H1.1: Though the knowledge management orientation construct is conceptualised as consisting of five distinct components, the covariance among the 30 items can be accounted for by a single factor (i.e. a general knowledge management orientation factor).
H1.2: Covariance among the items can be accounted for by a restricted five-factor model (namely the knowledge system, organisational memory, knowledge sharing, a learning culture and knowledge benchmarking), wherein each factor represents a particular conceptual component of knowledge management orientation and each item is reflective only of a single component (i.e. loads only on one factor). The five factors are correlated.
H1.3: Responses to each item are reflective of two factors: a general knowledge management orientation factor and a specific component factor corresponding to one of the five conceptual components. Thus the covariance among the items can be accounted for by a six-factor model.

3. Methodology

The methodological nature of this paper is hypotheses testing. Confirmatory factor analysis was employed to test the above highlighted hypotheses. Confirmatory factor analysis is deemed as one of the best-known statistical procedures for testing a hypothesised factor structure (Bollen, 1989; Schumacker and Lomax, 1996; Byrne, 2001). The statistical software AMOS 4.0 was used to perform confirmatory factor analysis. The Maximum Likelihood (ML) estimation method was employed. A total of 213 cases were included in the analysis.

The construct for knowledge management orientation as detailed in Appendix 1 was based on extensive review of the literature from both conceptual development and case-based empirical insights. A total of 30 items were generated for the five components of the knowledge management orientation construct. Data were collected using a self-administered questionnaire. The questionnaire uses 7-point Likert scale (ranging from 1=strongly disagree, to 7=strongly agree). A neutral option representing a 'neither agree nor disagree' answer was provided, since it has been ascertained that design techniques such as providing a 'don't know' or other neutral response options that reassure respondents that they need not feel compelled to answer every questionnaire item have proved effective in reducing but not eliminating uninformed response (Wilcox, 1994).

A sample of 1500 companies (with no less than 50 employees and primary trading address within England, Wales, and Scotland) randomly selected from the FAME Database were sent a questionnaire with a cover letter to the company director or senior executive, and a pre-paid return envelope. After two rounds of follow-up reminders a total of 231 completed questionnaires were received, representing 15.4% of response rate. After discounting non-valid and incomplete responses the rate for the usable responses is 14.2% (213 usable cases).

To check the non-response bias, the ANOVA test was performed to confirm the existence or absence of bias, as suggested by Armstrong and Overton (1977). Respondents were divided into three groups, the first mailing, the first follow-up and the second follow-up. It was assumed that the last group who responded to the second follow-up were most similar to non-respondents (Armstrong and Overton, 1977). Using ANOVA test, three groups were compared on all variables. The results revealed that there was no significant differences (at 5% significant level) between the three groups. Because the group sizes are unequal, the post-hoc Turkey's-b test using the harmonic means of the group sizes also evidenced that all the variables were homogenous (at 5% significant level) between three groups.

4. Confirmatory Factor Analysis

The model fitness is evaluated using several criteria, including the Chi-square Goodness-of-Fit test statistic, degree of freedom, Chi-square/df, Joreskog and Sorbom's Goodness-of-Fit index (GFI), Ajusted Goodness-of-Fit index (AGFI), the rescaled noncentrality parameter (NCP), Root-Mean-Square Residual (RMR), Normed

Fit Index (NFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and PCLOSE. The first regression path in each measurement component is fixed at 1 for model identification purpose.

All 30 items of the knowledge management orientation construct were initially incorporated into the model testing. Several criteria were used to evaluate the items, including each item's error variance estimate; evidence of items needing to cross-load on more than one component factor as indicated by large modification indices; the extent to which items gave rise to significant residual covariance; parsimony purpose; regression coefficient of each item; reliability of the item and the reliability of the whole construct. Additionally, the logic and consistency of data with the theoretical framework was considered when evaluating each item. As Kohli et al (1993, p470) noted, although from a measurement theory standpoint there is no intrinsic necessity to eliminate items potentially reflective of more than one of the sub-components, from a practical/managerial standpoint it might be desirable to have a scale consisting of single-component items, because this would allow the scale to be partitioned into subscales, each of which assesses a specific component of the construct. This recommendation was adopted in confirmatory factor analysis of this research, and severe cross-loadings of factors were eliminated from the final construct.

4.1 First-order confirmatory factor analysis

The initial KMO measurement model fit indices without any modification were: Chi-square =932.172, Chi-square/df=2.360, df=395, GFI=0.779, RMSEA=0.80, PCLOSE=0.000, PGFI=0.662, NFI=0.769, CFI=0.851, RMR=0.170, AGFI=0.740, NCP=537.172. The initial model needs to be improved to fit the sample data better. Using all the above criteria, 10 items were eliminated, and 20 items remained in the final construct of knowledge management orientation: 5 for knowledge-learning culture (K-culture), 3 for knowledge sharing (K-sharing), 4 for knowledge system (K-system), 4 for organisational memory (K-memory), and 4 for knowledge benchmarking (K-benchmarking). The following entails the data pruning process.

- Item 28 and 30 were eliminated based on the low squared multiple correlation which is 0.19 for item 28 and 0.14 for item 30. The estimated regression weights for both items were also the lowest from among the 30 items. The regression weight of knowledge-learning culture to item 28 was 0.44, while the regression weight of knowledge benchmarking to item 30 was 0.37.

- The modification indices (M.I.) showed that Item 4 and 5 had the highest residual covariation (M.I.=31.030). Item 4 is "we systematically de-brief projects, record good practices that we should extend and mistakes that we should avoid." Item 5 is "we make efforts to remember mistakes we made and avoid making similar mistakes in the future." From the theoretical viewpoint, both items are associated and thus likely to result in the high residual covariation. By further referring to error variance of both items, item 4 had a higher error variance (=1.44) while item 5 had error variance of 1.38. Therefore item 4 was eliminated from the construct.
- The second highest modification indices was between item 11 (of the second component: K-sharing) and the third component (K-system). This indicates that item 11 was cross loading to the K-system factor. As suggested by Kohli et al (1993), to avoid cross-loading, item 11 was eliminated from the subsequent analysis.
- The error covariance between item 24 and item 25 was very high as indicated in the M.I. (which was 26.968). Item 24 is "in our company, new ideas are evaluated equitably". Item 25 is "in our company, we evaluate ideas based on their merits, no matter who comes up with the ideas". However, both items were very close in either regression weights, or error variances, or squared multiple regressions. Therefore, decision was made on elimination of item 24, because the whole model fitness with item 25 was better than with item 24.
- By examining the error variances and regression weights of all remaining items, and testing the effects on remaining items if items with higher error variances were removed, item 8 and item 16 were further removed. The error variances were 1.18 (for item 8) and 1.23 (for item 16). Some variables with even higher error variances were retained in the construct, removing these items led to decreased effect of other items in the construct.
- The modification indices showed a strong regression from Item 14 to Item 5 (M.I.=16.325). When item 14 was removed, the model fit indices improved. Therefore item 14 was deleted.
- For parsimony purposes, item 22 and 27 were removed to improve the model fit indices.

A total of 10 items were removed from the construct, resulting in 20 items consisting of the knowledge management orientation construct. The re-specified first-order model fit indices are: Chi-square statistics=341.100, Chi-square/degree of freedom=2.132, Degree of freedom=160, GFI=0.866, RMSEA=0.073, PCLOSE=0.000, PGFI=0.660,

NFI=0.857, CFI=0.918, RMR=0.167, AGFI=0.824, NCP=181.100. These results indicate that the respecified model fits better to the sample data than did the original model. Table 1 is a summary of the respecified model outputs. From Table 1 it is easily noticeable that the regression weights of all variables loading onto their respective factors is between 0.46 and 0.90, with all critical ratios (t-value) above 1.96 (which means that all the regressions are statistically significant at 95% confidence level).

Table 1. Loadings Of First-Order CFA For KMO

Variables	R^2	**Standard first-order loadings ***				
		K-culture	K-sharing	K-system	K-memory	K-benchmark
KM25	.63	.80 ***				
KM26	.64	.80 (12.143)				
KM29	.40	.63 (9.280)				
KM23	.35	.59 (8.630)				
KM21	.50	.71 (10.486)				
**K-culture ** **		**-**	**.71**	**.50**	**.54**	**.78**
KM12	.76		.87 ***			
KM13	.81		.90 (15.714)			
KM15	.43		.65 (10.471)			
**K-sharing ** **			**-**	**.53**	**.55**	**.66**
KM3	.58			.76 ***		
KM1	.73			.85 (12.727)		
KM2	.71			.84 (12.576)		
KM20	.49			.70 (10.222)		
**K-system ** **				**-**	**.77**	**.70**
KM6	.62				.78 ***	
KM5	.33				.58 (8.231)	
KM7	.77				.88 (12.568)	
KM9	.21				.46 (6.508)	
**K-memory ** **					**-**	**.66**
KM10	.28					.53 ***
KM17	.55					.74 (7.236)
KM18	.70					.84 (7.625)
KM19	.40					.63 (6.632)
K-benchmark **						-
Chi-square statistics=341.100, Chi-square/degree of freedom=2.132, Degree of freedom=160, GFI=0.866, RMSEA=0.073, PCLOSE=0.000, PGFI=0.660, NFI=0.857, CFI=0.918, RMR=0.167, AGFI=0.824, NCP=181.100						

Notes to Table 1:

* Standard first-order loading is the standard regression weight of the individual variable's loading onto one of the subcomponents. Figures in parentheses are critical ratio (t-value) from the unstandardised solutions.

** Standard first-order loading for subcomponents (i.e. K-culture, K-sharing, K-system, K-memory, and K-benchmarking) is the covariance between any two of these subcomponents.

*** Critical ratio (t-value) is not available, because the regression weight of the first variable of each subcomponent is fixed at 1.

4.2 Second-order confirmatory factor analysis

The second-order confirmatory factor analysis is reported here to facilitate future adoption of the KMO measurement model in a full structural equation model. As shown in Figure 1 and Table 2, all the first-order five factors load very well onto the second-order KMO construct. The regression weights are very close with each other and range from 0.75 to 0.90, with all critical ratios (t-value) above 1.96. The model fit indices show similar result as the first-order confirmatory factor analysis: Chi-square statistics=388.844, Chi-square/degree of freedom=2.357, Degree of freedom=165, GFI=0.839, RMSEA=0.08, PCLOSE=0.000, PGFI=0.659, NFI=0.837, CFI=0.898, RMR=0.184, AGFI=0.795, NCP=223.844. The slight difference in estimations of the first-order and second-order confirmatory factor analysis occurs due to the emergence of slightly different degrees of freedom between executing the first-order and second-order measurement models.

The above statistics show that all the 20 items converge into a single KMO construct. The 20 items are partitioned into five subcomponents: K-culture, K-sharing, K-system, K-memory, and K-benchmarking. Each of the 20 items is loaded onto only one of these five factors, without any cross-loading. Therefore, convergent validity is established, and accordingly, the unidimensional representation of the KMO construct is supported.

Table 2. Loadings Of Second-Order CFA For KMO

Factors	R^2	**Standard Second-order loadings ***
		Knowledge Management Orientation
K-culture	.65	.81 **
K-sharing	.57	.75 (8.292)
K-system	.59	.77 (7.863)
K-memory	.60	.77 (7.874)
K-benchmarking	.82	.90 (6.502)
Chi-square statistics=388.844, Chi-square/degree of freedom=2.357, Degree of freedom=165, GFI=0.839, RMSEA=0.08, PCLOSE=0.000, PGFI=0.659, NFI=0.837, CFI=0.898, RMR=0.184, AGFI=0.795, NCP=223.844		

Notes to Table 2:

* Standard second-order loading is the standard regression weight of each of the first-order factor's loading onto the overall knowledge management orientation factor. Figures in parentheses are critical ratios (t-value) from the unstandardised solutions.

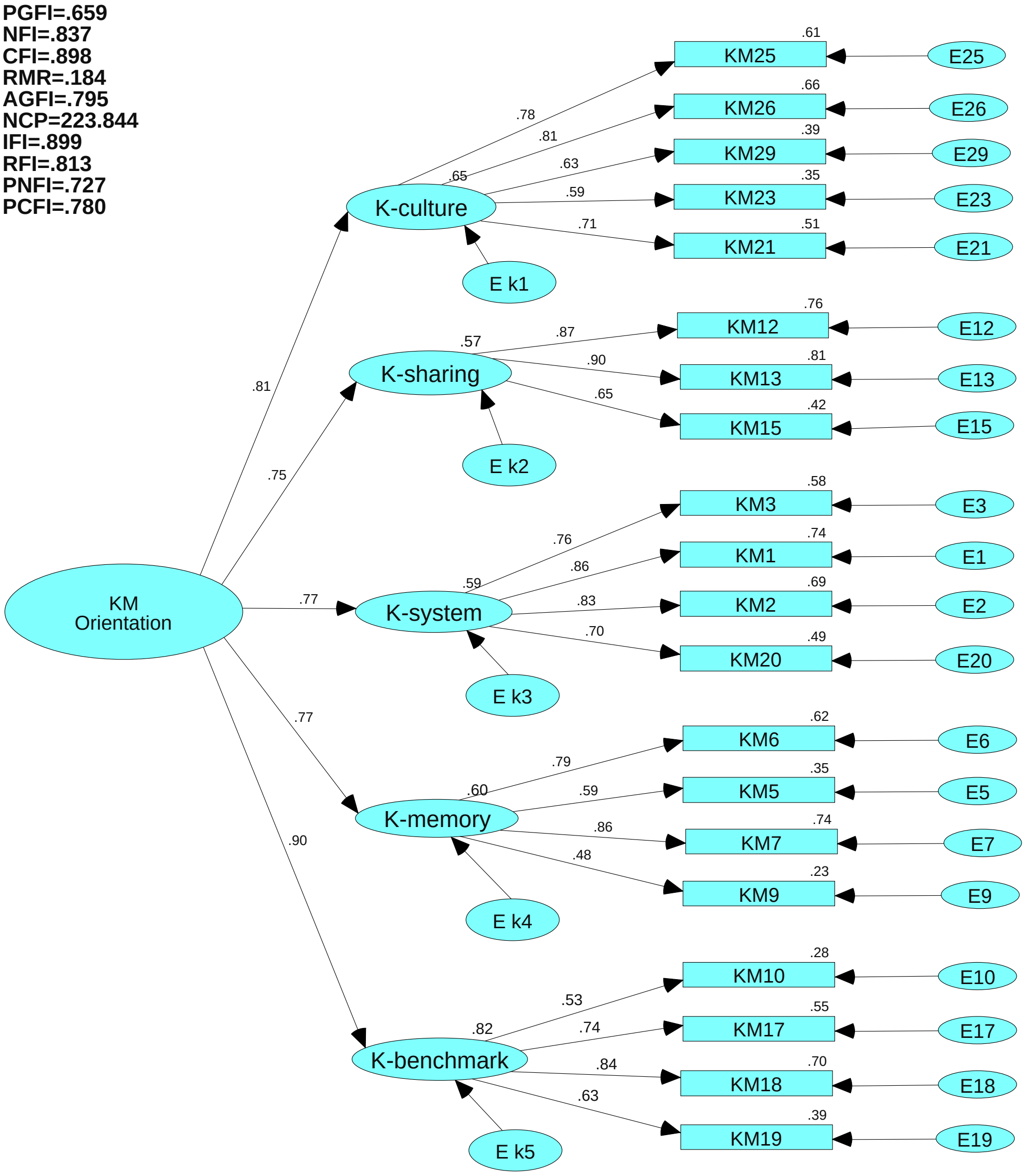
** Critical ratio (t-value) is not available, because the regression weight of the first regression weight (i.e. KMO → K-culture) is fixed at 1.

Figure 1. KMO- Second-Order Confirmatory Factor Analysis

Filename:Cfa.kmo1 bigtest1(final) b - second-order
KMO
Confirmatory Factor Analysis
Standardized estimates

Chi-Square=388.844
Chi-square/df=2.357
df=165
p=.000

GFI=.839
RMSEA=.080
PCLOSE=.000
PGFI=.659
NFI=.837
CFI=.898
RMR=.184
AGFI=.795
NCP=223.844
IFI=.899
RFI=.813
PNFI=.727
PCFI=.780



4.3 Validity and Reliability

The initial KMO construct was developed through extensive literature review. All items were checked against theories in terms of face validity and content validity. From the above confirmatory factor analysis, each variable only loaded onto one KMO component and the five components loaded onto one single general factor - KMO. Therefore, the convergent validity and unidimensionality of the KMO construct was tested and supported.

Reliability analysis was performed to test the internal consistency reliability. Cronbach's alpha coefficient was chosen, as suggested by Peter (1979) as the most commonly accepted approach for assessing the reliability of a multi-item scale. Nunnally (1976) recommended that the minimum acceptance standard of internal consistency reliability is 0.70. Price and Mueller (1986:6) note that 0.60 is generally viewed as the minimum acceptance level. In generic terms, the threshold of acceptance of reliability coefficients as equal to or greater than 0.60 has been used as the point of reference for most research work. As listed in Table 3, the alpha value of each of five components is over 0.7, and the overall alpha value is 0.9274. The reliability of the KMO construct is accepted.

Table 3. KMO Reliability Test

Components	Items	Item-total Correlation (I)	Alpha if Item Deleted (I)	Alpha of Components	Item-total correlation (II)	Alpha if item deleted (II)
K-Culture	KM25	.7272	.7674		.5881	.9211
	KM26	.6990	.7753		.6717	.9194
	KM29	.5777	.8109		.4802	.9234
	KM23	.5378	.8210		.5050	.9228
	KM21	.6045	.8024	.8299	.6645	.9196
K-Sharing	KM12	.7409	.7203		.6518	.9200
	KM13	.7647	.6981		.6699	.9197
	KM15	.5914	.8852	.8303	.5770	.9214
K-system	KM3	.7231	.8248		.5361	.9225
	KM1	.7718	.8039		.6567	.9196
	KM2	.7531	.8138		.6324	.9201
	KM20	.6173	.8659	.8653	.6684	.9193
K-memory	KM6	.6750	.6416		.5587	.9217
	KM5	.4893	.7435		.5730	.9215
	KM7	.6728	.6425		.6673	.9194
	KM9	.4215	.7767	.7612	.4302	.9245
K-benchmarking	KM10	.4318	.7849		.4881	.9230
	KM17	.6355	.6854		.6322	.9202
	KM18	.6971	.6520		.7151	.9186
	KM19	.5514	.7336	.7731	.5328	.9223

Notes to Table 3:

1. The scale used is a seven-point scale where 7=strongly agree, 6=agree, 5=slightly agree, 4=neither agree or disagree, 3=slightly disagree, 2=disagree and 1=strongly disagree.

2. The 'item-total correlation (I)' is the correlation of a particular item and *the total of the component* that it loads onto. The 'alpha if item deleted (I)' is the alpha value of the component that a particular item loads onto when this item is deleted.

3. The 'item-total correlation (II)' is the correlation of a particular item and the *total of the overall KMO construct*. The 'alpha if item deleted (II)' is the alpha value of the overall construct when a particular item is deleted.

5. Discussion and Conclusion

The KMO construct developed and tested in this paper distinguishes itself from existing IT-led process-based views of knowledge management. The construct not only captures the essence of managing knowledge management processes and technology as encapsulated in the knowledge system and organisational memory, but also underscores the fundamental enablers: knowledge sharing and a learning culture. Measuring knowledge assets and identifying knowledge gaps, which is enveloped in the aspect of knowledge benchmarking, is another important aspect that is missing from existing knowledge management measures. The knowledge management orientation measures an organisation's overall capability of effectively managing the five identified aspects. Therefore, the KMO measure in this paper clearly departs from the information system or information processing approach to knowledge management.

The empirical nature of this paper based on large-scale survey data provides more generalisable findings, which adjoin the existing case-based and theoretically based understandings. The construct was tested using confirmatory factor analysis of 213 cases through random sampling. Additionally, the KMO general factor consists of five components, each measuring a different aspect of an organisation's knowledge management capability. This proffers the opportunities of adopting each of the components independently. The unidimensionality of each component factor was tested using confirmatory factor analysis and reported in Table 1 and 2. The reliability of each component factor was tested and accepted as illustrated in Table 3.

From the methodological viewpoint, strictly speaking, the three hypotheses incorporating the initial 30 items were rejected. The hypotheses were modified to include 20 items rather than the original 30 items. All the five component factors remain the same. The respecified hypotheses were all accepted based on the overall assessment of the model fit indices. The respecified KMO measurement model demonstrated a relatively good fit with the sample data, as shown in Table 1 and 2. The final construct was checked against theories and demonstrated coherence.

A methodological limitation of this paper is the absence of retests. The development and validation of scales requires replications in a vigorous and systematic manner (Churchill, 1979; Anderson and Gerbing, 1988). The KMO construct is the first test and needs to be subject to further study. More items may be considered and the whole construct should be retested for validation. The discriminant validity and predictive validity of the KMO construct are not examined in this paper. When applying the KMO construct in future studies, both discriminant validity and predictive validity should be examined.

In conclusion, the task of this paper was to develop the KMO construct and validate the construct through confirmatory factor analysis. Although additional work is required particularly in the methodological domain, the results reported in this paper are promising. The findings provide a framework for measuring an organisation's knowledge management capability, as well as a path leading to further studies as recommended in this paper.

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Appendix 1. The Knowledge Management Orientation Construct

Code	Items	Mean	S.D.
KM1	We have systems to capture and store ideas and knowledge.	4.502	1.676
KM2	We have systems to codify and categorise ideas in a format that is easier to save for future use.	3.840	1.541
KM3	IT facilitates the processes of capturing, categorising, storing, and retrieving knowledge and ideas in our company.	4.310	1.696
KM4	We systematically de-brief projects, record good practices that we should extend in the future.	--	--
KM5	We make efforts to remember mistakes we made and avoid making similar mistakes in the future.	4.793	1.568
KM6	Information and knowledge stored in our systems is relevant and sufficient.	4.278	1.490
KM7	We constantly maintain our information systems and upgrade knowledge stored in the systems.	4.423	1.500
KM8	We treat people's skills and experiences as a very important part of our knowledge assets.	--	--
KM9	When we need some information or certain knowledge, it is difficult to find out who knows about this, or where we can get this information.	4.183	1.526
KM10	We very often use knowledge that our company possesses, either from the past experience or from external sources.	5.160	1.218
KM11	We have systems and venues for people to share knowledge and learn from each other in the company.	--	--
KM12	We share information and knowledge with our superiors.	5.080	1.299
KM13	We share information and knowledge with our subordinates.	4.981	1.296
KM14	We often share ideas with other people of similar interest, even if they are based in different departments.	--	--
KM15	There is a great deal of face-to-face communications in our company.	4.920	1.578
KM16	We use information technology to facilitate communications effectively when face-to-face communications are not convenient.	--	--
KM17	We use information technology to access a wide range of external information and knowledge on competitors and market changes, etc.	5.023	1.449
KM18	Through sharing information and knowledge, we often come up with new ideas that can be used to improve our business.	4.709	1.397
KM19	We have networks of sharing knowledge with other organisations on a regular basis.	4.225	1.500
KM20	People are encouraged to access and use information and knowledge saved in our company systems.	4.639	1.598
KM21	Managers value knowledge as a strategic asset, critical for success.	4.840	1.422
KM22	Our company culture welcomes debates and stimulates discussions.	--	--
KM23	We hesitate to speak out our ideas because new ideas tend to be highly criticised or ignored (R).	5.108	1.477
KM24	In our company, new ideas are evaluated equitably.	--	--
KM25	In our company, we evaluate ideas based on their merits, no matter who comes up with the ideas.	4.850	1.449
KM26	In our company, we evaluate new ideas rapidly on a regular basis.	4.127	1.466
KM27	There is a general culture in our company where people respect knowledge and knowledge ownership.	--	--
KM28	People who contribute new ideas are rewarded financially in our company.	--	--
KM29	People who contribute new ideas are invited to participate in future development and implementation of this new idea.	4.268	1.535
KM30	We are held accountable for our own actions and consequences.	--	--

(R) denotes reverse coded items.
Items with -- under the mean and standard deviation columns are deleted in the respecified model.