

## **Empirical Approach to Understand the Knowledge Management Process**

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### **Abstract**

Knowledge Management (KM) is a process that focuses on knowledge-related activities to facilitate knowledge creation, capture, transformation and use, with the ultimate aim of leveraging organisations' intellectual capital to achieve organisational objectives. The KM process receives input from its context (e.g. internal business environment), and produces output (i.e. knowledge). It is argued that the validity of such knowledge should be justified by business performance. The study, this paper reports on, provides enhanced empirical understanding of such an input-process-output relationship through investigating the interactions among different KM activities in the context of how construction organisations in Hong Kong manage knowledge. To this end, a theoretical framework along with a number of hypotheses are proposed and empirically tested through correlation, regression and path analyses. A questionnaire survey was administered to a sample of construction contractors operating in Hong Kong to facilitate testing the proposed relationships. More than 140 respondents from 99 organisations responded to the survey. The study findings demonstrate that both organisational and technical environments have the potential to predict the intensity of KM activities. Furthermore, different categories of KM activities interact with each other, and collectively they could be used to predict business performance.

### **Keywords**

knowledge management, organizational culture, technical environment, business performance, Hong Kong

### **1. Introduction**

This study was built on the premise that KM is a process that receives input from its context (i.e. business environment), and produces output that should be justified by business performance (Mouritsen, 2004). In other words, some factors within the internal business environment of business organisations can be manipulated to facilitate KM activities (Alavi and Leidner, 2001; Pillania, 2006), which help to achieve long-term organisational objectives (Sveiby, 1997). Therefore, this study is strategic in nature and aims to provide empirical evidences of the KM process and the interactions among different KM activities. The empirical understanding of this issue is presently limited (Egbu et al., 2003a). In order to achieve this research objective, a theoretical framework was designed to examine the relationships between the internal business environment, KM activities and organizational business performance within the single business environment of construction contracting organisations operating in Hong Kong.

## **2. Theoretical Framework**

### **2.1 KM Activities from a Strategic Perspective**

Within the construction context, the KM process has been perceived as a combination of a series of KM activities of identifying, capturing, sharing and measuring knowledge (Palmer and Platt, 2005). These activities interact with each other and form a strategic KM cycle that contributes to organisational long-term objectives (Hari et al., 2005). Therefore, in this study the KM activities are classified into four strategic dimensions (Abou-Zeid, 2002), which constitutes the four KM constructs of the theoretical framework, and are defined as: '*Responsiveness to knowledge*' (KR): responding to the various types of knowledge an organisation has access to, in its business environments (Darroch, 2003); '*Knowledge acquisition*' (KA): seeking and acquiring knowledge from the external environment and creating new knowledge based on existing knowledge within the organisation (Darroch, 2003; Gold et al., 2001); '*Knowledge dissemination*' (KD): creating and maintaining structures, systems and processes for sharing knowledge, and for retaining knowledge within the organisation (McCann and Buckner, 2004); and '*Knowledge utilisation*' (KU): utilising knowledge (Gold et al., 2001).

### **2.2 Internal Business Environment**

#### **2.2.1 Organisational environment**

'*Organisational environment*' (OE) covers organisational culture (value and principles) and organisational climate (rules, policies, procedures, structure, incentive systems, etc.). As KM is a value driven process, implementations of KM almost always require a cultural change, in the meantime, trigger a change that will in turn trigger a maturing or evolutionary process (Dalkir, 2005: 185). Therefore, organisational culture has been identified as a major catalyst (or alternatively a major hindrance) to knowledge creation and sharing (Pillania, 2006). Furthermore, the capacity of organisational culture in enabling changes of internal structure and system is recognised as a critical success factor for effective exploitation of organisational knowledge resources (Sutton, 2001).

#### **2.2.2 Technical environment**

Information systems are designed to support and to augment organisational KM need, in the meantime to complement and to enhance the KM activities of individuals and the organisation (Alavi and Leidner, 2001). '*Technical environment*' (TE) therefore refers to the technological infrastructure and its ability to respond to the increasingly dynamic work environment. Within the construction environment, effectively using information and web technologies in the project delivery process enables knowledge to be captured and managed to the benefit of future projects; and effective experience and knowledge sharing can lead to knowledge reutilisation, which can minimise the cost of problem solving, reduce the probability of repeating problems, and increase innovation ability (Tserng and Lin, 2004). It has been argued in the literature streams of IT and organisational culture (Gallivan and Srite, 2005) that organisational culture factors have impact on IT implementation, whilst adoption of IT to support knowledge sharing could also bring about a cultural change within organisations. This argument is also supported by recent construction-related studies (Egbu et al., 2003b; Stewart et al., 2004) giving rise to the proposition that both OE and TE do somehow affect each other.

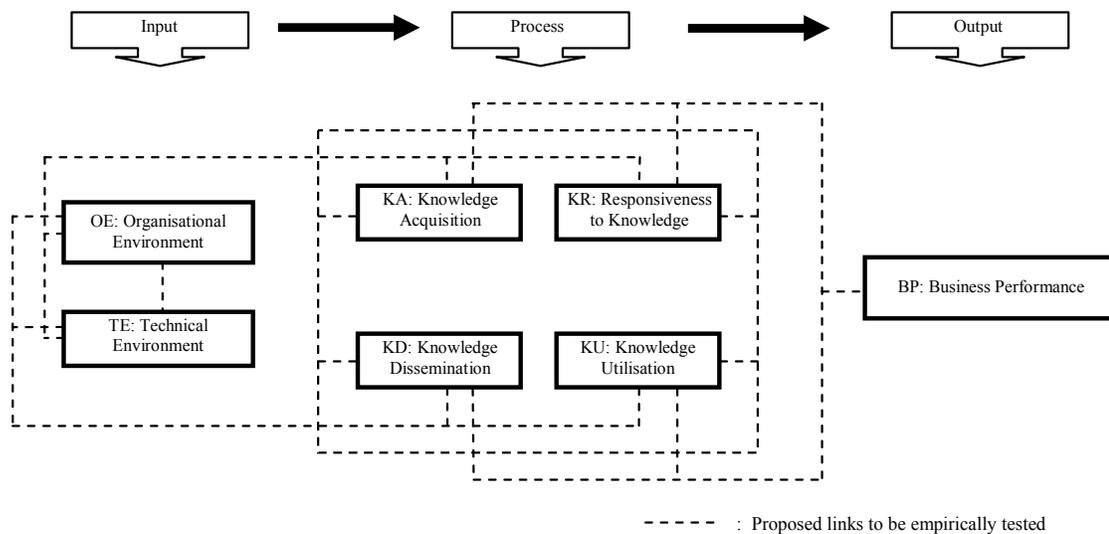
### **2.3 Business Performance**

KM focuses on building the successful link between knowledge and performance, hence its solutions should be measured according to organisational objectives. This study adopted the Balanced Score Card (BSC) to measure business performance, because 1) construction organisations have favoured the BSC for strategic management (Bassioni *et al.*, 2004); and 2) within the construction context, performance of KM activities can be better evaluated by a systematic framework developed based on the strategic map of the BSC (Yu and Chang, 2005).

Previous empirical and construction specific studies provide basic measurable variables for operationally defining the constructs. Details of the operationalisation can be found in Chen and Mohamed (Chen and Mohamed, 2005). The above discussion leads to the following four hypotheses of this theoretical framework:

- Hypothesis 1: Organisational environment (OE) and technical environment (TE) are positively related to each other in a recursive manner.
- Hypothesis 2: Organisational environment (OE) and technical environment (TE) are positively related to the intensity of the different categories of KM activities.
- Hypothesis 3: Different categories of KM constructs are positively related to each other.
- Hypothesis 4: Different categories of KM constructs are positively related to business performance.

The graphical illustration of the theoretical framework of the KM process is presented in Figure 1, which contains the seven constructs (OE, TE, KR, KA, KD, KU, BP) and the hypothetical relationships between them.



**Figure 1: Theoretical Framework**

### 3. Methodology

A cross-sectional study design was used to provide a snap-shot of the KM process within construction contracting organisations operating in Hong Kong. Data were gathered over a period of several months via a mail questionnaire survey to elicit opinions on the internal business environment, intensity of KM activities and business performance of targeted organisations. In the questionnaire, five-point Likert scales were used to measure the operationally-defined variables of the constructs within the proposed theoretical framework. The questionnaire was pre-tested with 10 local contractors. The data collection process began after the questionnaire had been finalised, based on the pre-test feedback.

The sample population comprising 260 contractors was randomly drawn from two trade directories, i.e. the “List of Approved Contractors for Public Works” (ETWB, 2005), and the “Members List” of the Hong Kong Construction Association (HKCA, 2005). Large- and medium-sized organisations represented the theoretical population because they provide a relatively better environment for KM compared to small organisations (Robinson et al., 2005). Self-administered questionnaires were mailed or delivered in person to the managerial/professional staff member(s) within targeted organisations. A total

of 143 usable responses were received from 99 organisations representing about 38% of the research population. No more than five usable (containing no missing data) feedback questionnaires were chosen from each organisation to avoid bias in the data. The responses were considered a good representation of the opinions of the population, since the majority of the respondents were middle-aged, educated, at peak of their career, experienced, and knowledgeable about KM operations within their organisations.

## **4. Data Analysis**

This study incorporated both exploratory and confirmatory analyses in summated scale development and relationship identification. Firstly, exploratory factor analysis (EFA) was applied to determine how and to what extent the measurement variables were linked to their underlying factors under each construct; then confirmatory factor analysis (CFA) was employed to confirm the structures of the summated scale. Based on these scales, correlation and regression analyses were performed to establish the general relationships between these constructs; then path models were assessed to simultaneously examine a series of dependence relationships in the 'contextual input – KM process – performance output' theoretical framework. Data examination, EFA and correlation and regression analyses were performed by the Statistical Package for Social Sciences Software (SPSS version 12.0). Version 5 of AMOS (Analysis of Moment Structure), the structural equation modelling software, was used to perform the CFA and path analyses. Data screening techniques were applied to all variables to assess their distribution to ensure that normality and linearity are reasonably upheld (Tabachnick and Fidell, 2001).

### **4.1 Measurement Development**

#### **4.1.1 Exploratory factor analysis**

EFA was adopted for identifying the structure among the set of measurement variables for each construct and also for data reduction. The VARIMAX method for orthogonal rotation under the component factor model was chosen to give a clear separation of the factors. The 143 cases met the acceptable sample size for undertaking the factor analyses (Hair et al., 1998: 98). Checks were undertaken to ensure factorability is upheld for all factor analysis scenarios. With the sample of 143, a factor loading of 0.50 and above was considered significant at the 0.05 level to obtain a power level of 80% (Hair et al., 1998:112); thus, variables having a factor loading of less than 0.50 were eliminated. Since the constructs were conceptually defined based on a combination of the literature review and previous empirical studies, the factors' scales were considered to have face validity (Hair et al., 1998:117).

#### **4.1.2 Confirmatory factor analysis**

The relations between the observed measurement variables and the underlying factors identified by the EFA, were postulated a priori and then tested by CFA (Byrne, 2001: 6). The CFA model of each construct was then evaluated by statistical means to determine the adequacy of its goodness of fit to the sample data. This study took a model generating approach, with a primary focus to locate the source of misfit in the model and to determine a model that better describes the sample data (Byrne, 2001). The fit indexes presented in Table 1 indicate very good overall model fit of the final CFA models of the seven constructs. To illustrate, the likelihood ratio tests reveal probability values ranging from 0.054 to 0.314. The values of the absolute fit measures of the models such as RMR, GFI and AGFI; and the incremental fit measures values such as NFI and CFI are indicative of a very good fit to data (Byrne, 2001: 83). In addition, the values of Akaike's information criterion (AIC); Browne-Cudeck criterion (BCC); and expected cross-validation index (ECVI) (lower compared with both the independence and the saturated models), and that of RMSEA suggest satisfactory model parsimony (Byrne, 2001). The values of Hoelter's critical N (CN) at 0.01 level exceed 200 indicating adequate sample size (Byrne, 2001: 87). Meanwhile, the analyses show sound feasibility of parameter estimates, which are statistically different from zero at level of 0.05. The correlation values between factors are much less than the high limit of 0.85, indicative of good discriminant validity (Kline, 2005). Modification indexes also present the absence of factor-cross loadings or error covariances. The reliability coefficients of all scales are above 0.80 reflecting very good

consistency (Kline, 2005). In view of the foregoing, the measurement scales represented by the final CFA models are considered of good validity and very good reliability to measure the constructs in the subsequent multivariate analysis.

**Table 1: Reliability and Model Fit Indexes of the Final CFA Models**

Model fit indexes (Value representing a well-fitting model*)	Constructs **						
	OE	TE	KR	KA	KD	KU	BP
<b>Model fit indexes*</b>							
Chi-square ( $\chi^2$ )	30.798	13.102	13.237	29.808	16.941	2.751	35.334
Normed Chi-square: $\chi^2/df$ (1.0-2.0) (df: degree of freedom)	1.185	1.456	1.655	1.569	1.303	1.376	1.104
$p$ (Probability level) (> 0.05)	0.236	0.158	0.104	0.054	0.202	0.253	0.314
RMR (Root mean square residual) (<0.05)	0.032	0.025	0.020	0.031	0.029	0.009	0.021
GFI (Goodness of fit index) (>0.90)	0.953	0.970	0.971	0.953	0.967	0.991	0.953
AGFI (Adjusted goodness of fit index) (>0.90)	0.919	0.930	0.923	0.911	0.929	0.955	0.920
NFI (Normed fit index) (>0.90)	0.939	0.964	0.968	0.922	0.951	0.988	0.933
CFI (comparative fit index) (= 0.95)	0.990	0.988	0.987	0.969	0.988	0.997	0.993
RMSEA (root mean square error of approximation) (<0.05)	0.036	0.057	0.068	0.063	0.046	0.051	0.027
<b>Reliability</b>							
Cronbach's Alpha	0.858	0.869	0.840	0.810	0.835	0.850	0.826
Notes: * reference : Byrne, 2001; Hair et al., 1998; Kline, 1998. ** OE: organisational environment; TE: technical environment; KR: responsiveness to knowledge; KA: knowledge acquisition; KD: knowledge dissemination; KU: knowledge utilisation; BP: business performance.							

## 4.2 Relationship Identification

### 4.2.1 Correlation and regression analyses

Correlation analysis was employed to investigate both the existence and strength of relationships between the constructs of the theoretical framework. Indicated by Pearson correlation  $r$  (coefficient of correlation) values significant at the 0.01 level (2-tailed), all BE and KM constructs are positively associated with one another, so are the KM and BP constructs. Stepwise regression analyses were then undertaken to explore the relationships hypothesised by the theoretical framework, by depicting how a specific construct being predicted and explained by the others. To pursue the stepwise analysis, a specific dependent variable (e.g. KA) was hypothesized as being influenced by a set of independent variables (e.g. OE and TE). The independent variables, which have strong correlations with a specific dependent variable, were entered step by step in its regression model. The significant model selected to predict this dependent variable has the largest adjusted  $R^2$  (the multiple coefficient of determination) of a power of 0.80 and significant at 0.01 level (Jaccard and Becker, 1997); and both F ratio for the overall model, and t-statistics for the regression coefficients significant at least at the 0.05 level (Bowerman et al., 1986). This suggests that the variables included in the final significant models are correct evidenced by their largest and significant predicting power. Checks were carried out to ensure the absence of multi-collinearity and multi-variate outliers among the independent variables. All assumptions of linearity, homoscedasticity and independence of residuals were met. The significant regression models that support the four hypotheses are presented in Table 2. These findings provide empirical supports to the four hypotheses (H1 through to H4).

**Table 2: Regression Models**

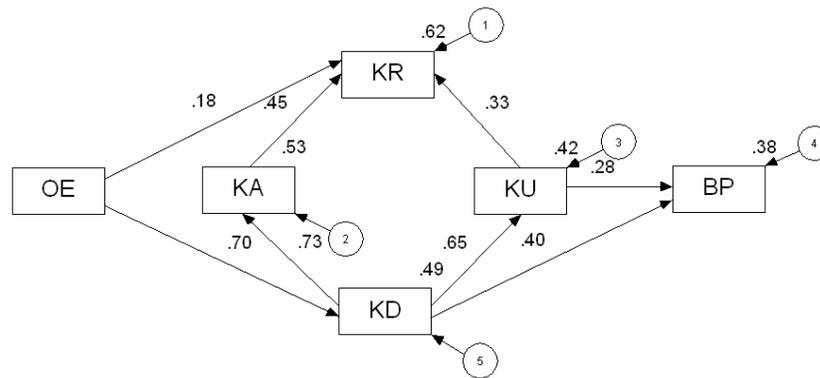
Supported Hypotheses	Significant regression models	R	R <sup>2</sup>	Adj.R <sup>2</sup>	F***
H1	OE = 17.339 + 0.685*** TE	0.529	0.280	0.275	54.515
	TE = 8.512 + 0.409*** OE	0.529	0.280	0.275	54.515
H2	KR = 9.322 + 0.342*** <b>OE</b> + 0.130* TE	0.641	0.411	0.402	48.428
	KA = 12.054 + 0.360*** <b>OE</b> + 0.258** TE	0.623	0.388	0.379	44.092
	KD = 3.541 + 0.478*** <b>OE</b> + 0.258** TE	0.731	0.534	0.528	76.916
	KU = 7.243 + 0.254*** OE	0.558	0.311	0.306	67.731
H3	KR = 3.055 + 0.407*** <b>KA</b> + 0.533*** <b>KU</b>	0.783	0.613	0.607	109.863
	KA = 6.876 + 0.494*** <b>KR</b> + 0.445*** <b>KD</b>	0.787	0.619	0.614	109.848
	KD = -2.579 + 0.562*** <b>KA</b> + 0.692*** <b>KU</b>	0.802	0.643	0.637	120.452
	KU = 3.782 + 0.271*** <b>KR</b> + 0.219*** <b>KD</b>	0.711	0.505	0.498	68.324
H4	BP = 12.049 + 0.438*** <b>KD</b> + 0.638** <b>KU</b>	0.641	0.411	0.401	41.185
Notes: ***: significant at 0.0005 level; **: significant at the 0.01 level; *: significant at the 0.05 level. The independent variable with larger predicting power is bold.					

**4.2.2 Path analysis**

Based on the findings of the correlation and regression analyses, a path model was formed to simultaneously estimate a series of separate, but interdependent, multiple regression equations in the KM process. In the model fitting process the insignificant links represented by regression weights of *p* value larger than 0.05 were removed. In the final path model, the estimates of both regression weights and variances are statistically different from zero at level of 0.05. Table 3 reports the regression weights of both initial and the final path models. Figure 2 illustrates the final path model of KM process, and presents its fit indexes indicative of satisfactory fit to data. The path analyses provide a strong empirical evidence for the existence of causal relationships between OE, KM and BP constructs. In addition, OE is found of much stronger impact on the intensity of KM activities than TE.

**Table 3: Regression weights of the Initial and Final Path Model**

Path link	Initial path model				Final path model			
	Regression weight	SE	CR	<i>p</i>	Regression weight	SE	CR	<i>p</i>
KA ← OE	-0.195	0.209	-0.931	0.352	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
KD ← TE	0.495	0.307	1.609	0.108	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
KD ← OE	0.858	0.398	2.157	0.031	0.578	0.049	11.714	***
KU ← KD	0.281	0.049	5.784	***	0.359	0.035	10.176	***
KU ← OE	0.092	0.04	2.291	0.022	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
KR ← KA	0.349	0.051	6.796	***	0.349	0.05	7.033	***
KR ← KU	0.449	0.088	5.101	***	0.449	0.084	5.351	***
BP ← KD	0.424	0.093	4.571	***	0.424	0.093	4.571	***
BP ← KU	0.549	0.168	3.272	0.001	0.549	0.168	3.272	0.001
KR ← OE	0.113	0.043	2.626	0.009	0.113	0.039	2.888	0.004
KD ← KA	-1.036	1.066	-0.972	0.331	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
KA ← KD	1.144	0.35	3.266	0.001	0.708	0.055	12.772	***
Note: SE: standard errors; CR: critical ratio; <i>n</i> : deleted links; ***: < 0.0005.								



Notes:  
 Absolute fit indexes:  $\chi^2$ : 13.166 (df:7);  $p$ : 0.068; GFI: 0.969; AGFI: 0.907.  
 Incremental fit indexes:  $\chi^2$ /df: 1.881; NFI: 0.974; CFI: 0.987.  
 Parsimonious fit indexes: RMSEA: 0.079  
 Sample adequacy: Hoelter's critical N at 0.01level: 200 indicative adequate sample size.

**Figure 2: Final Path Model of KM Process with Standardised Estimates**

## 5. Conclusions

The empirical study supports that 1) organisational and technical environments can be manipulated to increase the intensity of KM activities, especially those for disseminating and utilising knowledge; 2) KM activities interact with each other in a cycle like pattern, which implies that increased intensity of one type of KM activities help to push those of the other type into a higher level; 3) the higher the intensity of KM activities is, the better the business performance becomes. These findings suggest that through strengthening strategic guidance and encouraging innovation, construction organisations can more effectively facilitate KM, which should lead to improved business performance.

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