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The Effect of Knowledge Management on Product Innovation - Evidence from the Chinese Software Outsourcing Vendors*

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ABSTRACT

The knowledge acquisition and exploitation are becoming more and more for local vendors in offshore outsourcing cooperation. In the process of product innovation, internal knowledge sharing (*IKS*), *external knowledge acquisition* (*EKA*) *and their interactive relationship is discussed. Through the using of the method of* 3*SLS, the results of STATA indicate that IKS and EKA positively complement for product innovation. Furthermore, the result of SPSS reveals that knowledge exploitation mediates the* (*IKS*) *EKA and product innovation.*

Keywords: *Knowledge Management, Innovation, Outsourcing Cooperation*

1. Introduction

Offshore outsourcing cooperation is becoming very popular among local vendors not only as an effective tool for market access but also as an effective means to learn from foreign buyers. Cooperation often entails a transfer of certain value-chain activities from foreign firms from the developed economies to local firms in the emerging economies such as China and India. In order to improve their innovation, the local vendors hope to improve their innovation through cooperation. In this case, knowledge acquisition is an integral part of local vendors' motive to engage in international cooperation.

Despite of the growing importance of offshore outsourcing cooperation, there are some major limitations in the extant literature. The prior research emphasizes the importance of external knowledge acquisition, thereby ignoring the increasing importance of effect of the internal relative knowledge on external knowledge in innovation process, which leads to the inefficient innovation. The impact of internal knowledge sharing and external knowledge acquisition on product innovation has not been studied in an integrated model [1]. Furthermore, knowledge creation does not necessarily lead to performance improvement or value creation, and the efficiency of knowledge exploitation should impact the innovation and firms' competitive advantages. Thus, it should be very important for firms to understand the effect of relationship between the IKS (EKA) and exploitation on the innovation so that they can improve the effect of knowledge management on the product innovation efficiently.

To fill these gaps, drawing on the perspectives of knowledge management and absorptive capabilities, we construct a theoretical framework to examine relationships among IKS (EKA), exploitation and product innovation from the view of Chinese vendors in outsourcing cooperation. Empirically, using 172 samples collected through face-to-face interviews of senior executives in Chinese firms, we examine the interactive relationship between IKS (EKA) and production, and test the mediating effect of knowledge exploitation.

The paper proceeds as follows. First, by reviewing current literatures on knowledge management and absorptive capacity, we present a conceptual model we used to examine the knowledge assimilation and exploitation processes. Next, we discuss the relationships between IKS (EKA) and exploitation processes and product innovation, and present the hypotheses correspondingly. Third, we describe the study method and the empirical results, and finally we discuss our findings and offer concluding comments.

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2. Theoretic Background and Hypothesis Development

Knowledge management has been defined as the process of identifying/creating, assimilating, and applying organizational knowledge to exploit new opportunities and enhance organizational performance. To survive and keep competitive advantage in turbulent environment, local vendors must create knowledge or acquire the knowledge about the outsourcing business and the customer's needs. We define IKS as the process in which based on the routines, different employees and units share, process, interpret and understand the knowledge. EKA refers to the process in which local vendors process, interpret and understand the knowledge from partners. IKS and EKA are two important knowledge sources that can be important source of innovation [2], and they play a key role in overcoming resistance to innovations and in the reduction of uncertainty.

Absorptive capacity is a firm's ability to utilize externally held knowledge through three sequential processes: 1) recognizing and understanding potentially valuable new knowledge from the partners through exploratory learning, 2) assimilating valuable new knowledge through transformative learning, and 3) using the acquired knowledge to create new knowledge and commercial outputs through exploitative learning [3]. The incentive mechanism, R&D intensity and customer's knowledge within the firms influence the efficiency and the effectiveness of the firm's absorptive capacity [4]. External environment factors, such as outsourcing environment, knowledge produced by partners, also influence on absorptive capacity. Absorptive capacity will influence on external knowledge acquisition and exploitation. Absorptive capacity influence commercial outputs (products, services, and patents) and knowledge outputs [5]. The success of the commercial outputs and the new knowledge created can influence the future investment in absorptive capacity. IKS increases member interaction and facilitates the free flow of knowledge. The process involves social interactions among individuals using internal communication channels for knowledge transfer to arrive at a common understanding. Where organizational units hold specialized knowledge, inter-unit linkages are the primary means of transferring the customer's knowledge [6]. The higher level of internal knowledge is helpful for firms to understand and acquire the customer's knowledge. External knowledge sources enable the firms to develop needed capabilities quickly, leading to flexibility and reducing costs. EKA also can help firms accumulate relevant experiences and routines for knowledge sharing and interpretation, thus which can promote the local firm's absorptive capabilities [7].

2.1. IKS and EKA as Complements

IKS emphasizes to build routines and norms, communicate and share knowledge from different units, while EKA pertains to availability of channels for securing knowledge and to the possibility of understanding and exploiting external knowledge. Furthermore, they interact with each other as complements.

First, to create more value from IKS, firms should integrate the knowledge resources in which effectively combine the knowledge [8]. IKS can be regarded as one of integrative capabilities [9], and it helps firms build the reputation in the outsourcing market, as the customers (buyers) are more willing to collaborate with the firms having a higher level of internal capabilities [8]. Thus, the higher level of IKS is helpful for firms have more access to the customer's knowledge about technology and marketing. Additionally, a higher level of IKS stands for higher level of absorptive capacity, which helps firms learn more from their partners and create more value from the opportunities provided by their partners [3]. Thus, if an employee or unit cooperates closely with other employees or units, norms of cooperation will be established. These norms are reflected in the process of EKA as well. Therefore, in the process of IKS, firms can build good norms of knowledge transferring and sharing, which also leads to easily acquire the knowledge from partners.

Second, in the process of EKA from the customers, firms can recognize and find opportunities, and learn the routines about knowledge sharing and transferring from the customer, which can enhance the capabilities of knowledge management [6]. The capabilities enhancement of the firm mitigates the obstacle to knowledge sharing between different units inside the firm. Therefore, through EKA, firms can reduce the costs of knowledge coordination, and then IKS becomes more effective. In order to be effective in external cooperation, organizations need well-functioning internal interfaces. The routines of external cooperation also directly influence the efficiency and efficacy of the internal sharing vice versa. Thus, in the process of EKA, firms can also promote the IKS.

Furthermore, in the context of dynamic environment, IKS are not enough for firms to implement innovation, since they are very likely to be deficient of complementary knowledge. In order for firms to fully extract value from their IKS, firms should have outsourcing cooperation through which they can mobilize complementary external knowledge and identify more rewarding opportunities. IKS can help the firms to use the complementary external knowledge that can be obtained on the basis of EKA. Lacking IKS, firms may have difficulty in gener-

ating value from their EKA. Therefore, we suggest:

H1a: increases in IKS will enhance the level of EKA.

H1b: increases in EKA will enhance the level of IKS.

H1c: IKS and EKA will complement for product innovation.

2.2. The Mediating Effect of Knowledge Exploitation

The abundance of knowledge resources does not guarantee that the firms will excel in, or practice, effective innovation, and efficient exploitation of knowledge is key work of obtaining good performance. Especially, if lacking the capabilities of knowledge exploitation, firms will have obstacle in product innovation [10]. Only interpreting and exploiting the knowledge, firms can promote innovation.

Through efficiently exploiting knowledge, firms can leverage and recombine the knowledge to pursue product line extension or new product development. In the process of the knowledge exploitation, firms can enhance innovation capabilities, which through the process of bisociation, help firms to develop new schema or changes to existing process. Furthermore, firms can convert these changes into innovation product [11]. After integrating the knowledge, firms can fully and systematically apply the knowledge of different units. Therefore, quickly integrating the knowledge from different units inside firm, firm can reduce the cost of process. Comparing with the other vendors, the firm can have the higher level of innovation. In the process of knowledge exploitation, firms can also develop the new technological and market capabilities. The development of functional capabilities can promote R&D and understand the customer's needs, which is helpful for product innovation. Finally, through effective knowledge exploitation, firms can improve their flexibility in grasping the opportunities, which makes firms have advantage in product innovation [12].

H2: *The knowledge exploitation has a mediating effect on knowledge assimilation and product innovation.*

3. Methodology

3.1. Sample and Data Collection

To test the hypotheses, a questionnaire survey research method was used to search responses from some software firms with offshore outsourcing cooperation in the Shaanxi and Shandong provinces of China. A total of 300 local firms involved in offshore outsourcing cooperation were selected from the list provided by the local government agencies. We had three sampling criteria: the firms had to be 1) at least engaging in offshore outsourcing cooperation with 3 years; 2) at least 30 employees. A total of 211 questionnaires were collected, and other 89 firms could not provide their information due to such reasons as their mergers and acquisitions, business changes, and turnover of top management team, among others. Out of 211 returns, a total of 172 firms provided complete data. The data was collected in the summer of 2009. Therefore, 172 enterprises had all the necessary data. The effective rate was 57.73 percent (172 out of 300).

Two commonly raised issues concerning survey methodology are non-response bias and common method variance. Using t-tests, we compared the responding firms with 89 non-responding firms as well as 39 firms whose data could not be used with respect to the firm attributes of firm size, ownership status, and sales based on the public data from the Statistical Yearbook and the Directory of Enterprises at the provincial level. None of the t-statistics was significant. To further verify if our sample was representative of the whole population, we compared the sample's firm size, ownership status and sales to those of the national population using the information from the China Statistical Yearbook at the national level. Again, none of the t-statistics was significant. Also due to the relatively high responding rate, we did expect any non-response bias in the data of this study.

3.2. Measurement

We consulted the extant literature to compile measurement items. As noted some items were modified to reflect the specific context of the study. New questions were developed based on a review of the inter-firm cooperation literature. All constructs were measured by the average of the responses, on a 7-point Likert scale.

IKS: Following the work of Chen and Huang (2007) [13], we measure the IKS with five items. The items include: 1) corporate managers share the information about customers with employees; 2) employees will transfer the information of customers to managers; 3) different units have stronger aspiration to learning each other; 4) employees can easily share the knowledge; and 5) firms encourage employees from different units and hierarchy to share knowledge; 6) encourage employees to participate in decision making; 7) encourage employees to learn through teaching, guidance, and training.

EKA: Based primarily on a measurement instrument created and validated by Lyles and Salk (1996) [14], we adjusted their measures to fit our research better. Four indicators used here are: through cooperation, we have acquired much knowledge from partners, they are: 1) new technological expertise; 2) new marketing expertise; 3) manufacturing process; and 4) experience in the entrance of new market.

Knowledge exploitation: following the work of Song *et al.* (2005) [15] and Chen and Huang (2007) [13], we

measure the knowledge exploitation with five items. They are 1) a strong emphasis to put know-how, patents, and new product designs into practice; 2) a strong tendency to use the advanced technologies introduced into firm; 3) a strong tendency to adopt the advanced management techniques introduced into firm; and 4) a strong tendency to employ various experts introduced into firm; 5) a strong tendency to employ various experts introduced into firm.

Product innovation: following the work of Danneels and Kleinschmidt (2001) [16], we measure the product innovation with four items. Four indicators used here are: 1) develop a large number of types of new product; 2) improve the quality of the products; 3) expedite the introduction of these new products to the market; 4) introduce a large number of process technologies.

3.3. Reliability Analysis

Initially, an exploratory factor analysis (EFA) with the SPSS was used to purify the original measures (total of 20 items), and the measures showed evidence of validity and reliability once items with low loadings and high cross loadings were eliminated. This process resulted in the retention of 16 of the original 20 items. A confirmatory factor analysis (CFA) by means of LISREL 8.54 was also conducted to further validate the measures. All items from the EFA remain in the final measurement model, which demonstrates good fit.

Composite reliability assesses the inter-item consistency, which was operationalized using the internal consistency method that is estimated using Cronbach's alpha. Typically, reliability coefficients of 0.70 or higher are considered adequate [17]. Therefore, an alpha value of 0.70 was considered as the cut-off value. In **Table 1**, Cronbach's alpha values of all factors were above 0.70. These results suggest that the theoretical constructs exhibit good psychometric properties.

3.4. Method of Analysis

Since the hypotheses involve mutual relationship between IKA and EKA, the relationship between independent variables and dependent variables is blurred. Thereby, we need to test two equations simultaneously. First, we must test whether EKA is influenced by IKA. Second, and simultaneously, we must test whether IKA is influenced by EKA. Specifying and testing these two equations independently would, of course, introduce significantly biased estimates due to the endogeneity of key independent variables (IKA and EKA) in all equations and due to common disturbances across equations.

In order to eliminate the effects on regression estimation by endogenous variables, our econometric approach is a simultaneous equation estimation using a three-stage least squares method. This method uses generalized least squares (GLS) on the basis of two stages least squares (2SLS) to test equations simultaneously, then resolves

Table 1. Construct factors.

Factors	Variables	Loading	alpha
Internal Knowledge Sharing	Corporate managers share the information about customers with employees	0.710	0.762
	Employees will transfer the information of customers to managers	0.709	
	Different units have stronger aspiration to learning from each other	0.761	
	Employees can easily share the knowledge	0.807	
	Firms encourage employees from different units and hierarchy to share knowledge	0.732	
External Knowledge Acquisition	new technological expertise	0.804	0.882
	new marketing expertise	0.886	
	manufacturing process	0.892	
	experience in the entrance of new market	0.805	
Knowledge Exploitation	a strong emphasis to put know-how, patents, and new product designs into practice;	0.711	0.829
	a strong tendency to use the advanced technologies introduced into firm;	0.807	
	a strong tendency to adopt the advanced management techniques introduced into firm;	0.781	
	a strong tendency to employ various experts introduced into firm;	0.771	
Product Innovation	develop a large number types of new product	0.829	0.809
	improve the quality of the products	0.824	
	expedite the introduction of these new products to the market	0.821	

the problem of relativity between endogenous variables random disturbances (Stata, 1999). Stage 1 of this procedure can be thought of as producing instrumented values of all endogenous variables. These instrumented val ues are essentially predicted values generated by the regression of each endogenous variable on all exogenous variables in the system. Stage 2 produces a consistent estimate of the covariance matrix of the equation disturbances. Estimates are obtained from the residuals produced from a two-stage least squares estimation of each structural equation. Finally, Stage 3 performs a GLS-type estimation using the covariance matrix from Stage 2 and with the instrumental values replacing all endogenous right-hand side variables.

By correctly specifying this system of equations, we can test for a pattern of complementarity between IKA and EKA. If IKA positively affects EKA and EKA positively affects IKA, their complementarity is supported. We adopt the software of STATA to demonstrate this proposition.

In order to test the mediate relationship of knowledge exploitation between IKS and EKA and product innovation, we establish regression equation in which firms' product innovation is dependent variable and IKS, EKA and knowledge exploitation are dependent variables. Then we use SPSS to estimate the coefficients of equation.

3.5. Analysis and Results

The descriptive statistics in **Table 2** show basic information on each factor and correlations among these factors.

Table 3 and **Table 4** present the results. In **Table 3**, the critical test of the relationship, as complements between IKS and EKA, hinges on the sign and significance of coefficients for IKS and EKA in the two equations. Positive coefficients suggest a complementary relationship in which IKS predicts greater EKA and greater EKA predicts greater IKS. Consistent with our hypothesis of a complementary relationship, we find that increases in the level of IKS are associated with greater levels of EKA (Hypothesis 1a, see Equation (1)) and that increases in the level of EKA are associated with greater levels of IKS (Hypothesis1b, see Equation (2)).

In **Table 4**, Model 1 and Model 4 are the base models that include only the control variables. Adopting the procedure recommended by Baron and Kenny (1986), we tested the mediating effect of knowledge exploitation on IKS，EKA and product innovation relationship. In the first step, the dependent variable, product innovation, was regressed on the independent variable of IKS and EKA. As shown in Model 2, IKS and EKA have signifi-

Table 2. Descriptive Statistics and Pearson Correlation Matrix (N = 172).

Variables	Mean	S.D.	1	2	3	4	5	6
1.Firm size	3.345	1.459	1					
2 In industry the rate of new products is high	4.083	1.532	0.148	1				
3.Internal knowledge assimilation (IKS)	4.598	0.828	0.082	0.301**	1			
4.External knowledge assimilation (EKA)	3.535	1.709	0.063	0.085*	0.171**	1		
5.Knowledge exploitation	3.752	1.123	0.092**	0.163**	0.308**	0.188**	1	
6.Product innovation	4.447	1.079	0.081	0.182**	0.277**	0.131**	0.564**	1

Table 3. Assessing the determinants and complementarity of IKS and EKA.

Variables	Determinants of EKA	Determinants of IKS
	Equation 1	Equation 2
Internal knowledge assimilation (IKS)	0.657*	
External knowledge assimilation(EKA)		0.213***
Firm size	0.092	0.037
In industry the rate of new products is high	0.019	0.093**
Constant	1.251	1.301
N	172	172
Chi-square	124.341	183.626
F-value		
P-value	0.000	0.000
R-square	0.133	0.158

+p<0.10; *p<0.05; **p<0.01; ***p<0.001

Table 4. Results of OLS Regression (N = 172).

	Product Innovation			Knowledge exploitation	
Dependent variable	Model 1	Model 2	Model 3	Model 4	Model 5
Size	0.082**	0.077**	0.039	0.103**	0.097**
In industry the rate of new products is high	0.110***	0.103*	0.062*	0.091***	0.047
Internal knowledge assimilation (IKS)		0.285***	0.006		0.347***
External knowledge assimilation (EKA)		0.201***	0.003		0.336***
Knowledge exploitation			0.471***		
R Square	0.061	0.115	0.347	0.103	0.155
F Value	13.235***	15.846***	49.123***	14.003***	20.133***

$^{+}p<0.10$; $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

cant positive effect on product innovation. Therefore, it supports the Hypothesis1c. In the second step, the mediator of knowledge exploitation was regressed on the independent variable of IKS and EKA. The result shown in Model 5 indicates that IKS and EKA have a significant positive impact on knowledge exploitation (β = 0.347, $p < 0.001$, β = 0.336, $p < 0.001$). The third step was to examine the relationship between the mediator and the dependent variable. The result shown in Model 3 indicates that knowledge exploitation has a significant positive effect on product innovation (β = 0.471, $p <$ 0.001). At the same time, the impact of IKS on product innovation becomes not significant anymore (β = 0.006), which indicates a full mediation effect. Similarly, knowledge exploitation also has a full mediation effect on the relationship between EKA and product innovation. Taken in whole, hypothesis 2 is supported.

4. Discussion

Based on knowledge management perspective, this paper studies the relationship between IKS and EKA, knowledge exploitation and product innovation. The complement relationship between IKS and EKA is discussed. Furthermore, we also test the mediating effect of knowledge exploitation on the relationship between IKS (EKA) and product innovation.

Under turbulent environment and international competition, to implement indigenous innovation strategy, Chinese firms should search for technology and market knowledge in time. However, the abundance of manufacturing resources does not guarantee that the firm will excel in, or practice, effective manufacturing integration (Hitt, Hoskisson, and Nixon, 1993). Chinese firms should understand that knowledge creation and assimilation is necessary for innovation, but not sufficient. In the process of product innovation, firms should emphasize the knowledge exploitation.

Second, IKS and EKA are important knowledge source mode. Firms should encourage every employee and unit to share the knowledge through necessary award. Communication in different units can enhance the efficiency of assimilation of the external knowledge. The good relationship with suppliers, customers and universities will lead firms to have access to many skill and experiences. Hence, EKA can enhance the firms' absorptive capacity.

5. Future Research

Like all empirical research, this study has some limitations that should be addressed in future research. One caution is that the results of the current study are the context of software offshore outsourcing cooperation. Although we believe that it is theoretically feasible to extend this study to other contexts, the specific differences between China and other transition economy countries restrict the adaptive capacity of our findings. Therefore, the other useful extension would be to conduct this study in other transitional environments. Moreover, the cross-sectional data used in the study do not allow for causal interpretation among the factors, although we requested that the sample firms supply data during the previous five-year period. Then, longitudinal approach will be needed in future studies.

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