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The effect of absorptive capacity on innovation performance: Empirical research on the mediating effects of knowledge transfer efficiency

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ABSTRACT

The objective of this study is to analyze the mechanism of absorptive capacity in the course of innovation for the purpose of improving the innovation performance of the firms. This paper set the knowledge transfer efficiency as the intermediate variable based on the theory of capability level, analyzing the path and effect on innovation performance in all dimensions of the absorptive capacity. The research results show that absorptive capacity as a kind of high-level capability, the absorptive capacity can influence the innovation performance through the knowledge transfer efficiency. Each dimension of the absorption capacity produces different effects. Firms should pay attention to and treated differently in the process of technological innovation.

KEYWORDS

Innovation performance; Absorptive capacity; Knowledge transfer efficiency; Higher level capabilities.



INTRODUCTION

In the process of technological innovation, firms utilize absorptive capacity to acquire, integrate and use the external knowledge resources, making the knowledge transfer effective between internal and external firms and improve the technological innovation ability. Absorptive capacity is a dynamic capability, which can integrate and reconstruct the internal and external in order to cope with the fast changing environment^[1]. According to the theory of hierarchies of competence, the firm short-term viability is one of the general abilities which belong to lower-order hierarchy. While the dynamic capability is a higher-order capacity about the extension, change, or creation of general ability, and it can also determine the direction and speed of the changes of general ability^[2]. In the process of technological innovation, the characteristics of the absorptive capacity as a higher-order ability reflects in that it can influence the ability of routine management so as to enhance core competence to adapt to the constantly developed technological innovation needs. Existing research has proved that the absorptive capacity can change the technological innovation performance^[3]. However, how absorptive capacity affects and restricts the technological innovation performance in technological innovation activities, and plays the role of higher-order ability in the process is still lack of empirical research. In this article, from the view of knowledge transfer of technological innovation activities, we apply knowledge transfer efficiency as the intermediate variable, and use the theory of hierarchies of competence to study the mechanism of absorptive capacity acts on technological innovation. The purpose of the article is to help firms promote technological innovation ability and innovation performance.

THEORETICAL OVERVIEW AND HYPOTHESES

Absorptive capacity and innovation performance

The process of technological innovation comprises acquiring, diffusing, sharing and using knowledge. Absorptive capability is composed of multiple dimensions. In order to effectively show the different effects of various dimensions of knowledge absorptive capability, this article adopts the classification of Zahra^[4], which divides absorptive capacity into four dimensions--- acquisition, assimilation, transformation, exploitation of knowledge.

The firm can realize transfer knowledge resources inside and outside, by acquiring innovative information externally which is conducive to building the system of technological innovation resources. Knowledge absorptive capacity can help a firm identify the value of external knowledge and its contribution to enhancing the core competitiveness. In addition, acquisition capability is beneficial for a firm to choose appropriate ways to obtain knowledge outside in order to provide continuous external resources applied into knowledge exploitation and innovation for a firm. Knowledge assimilation capability can promote the firm's structure of knowledge reserves^[5]. The process of assimilation helps a firm apply the existing cognitive framework to understand new knowledge, and store specific knowledge for improving knowledge internalization and socialization. Thereby, the firm will realize the opportunities in market and grasp the direction of technological innovation. The process of transformation includes sharing, combination and innovation of absorbed knowledge. By sharing and integrating knowledge from different sources and levels, a new knowledge system will be shaped and it is beneficial to promote organizational performance^[6]. Knowledge exploitation capability can satisfy the needs of action-oriented activities, such as experiment and design, and can convert knowledge advantages into competitive advantages which are essential to the process of innovation. Therefore, we hypothesized that:

H1: Knowledge (1)acquiring, (2) assimilation, (3) transformation and (4) exploitation are positively related to the innovation performance in firms.

Absorptive capacity and knowledge transfer efficiency

Among the various capabilities affecting technological innovation activities, absorptive capacity impels knowledge move inside the firm as the need of technological innovation and influence the knowledge-transfer progress^[7]. Routine managements, such as adjusting organization structure and constructing organization system, have an effect on knowledge transfer efficiency^[8]. In other words, the efficiency of knowledge transfer reflects firms' general ability of knowledge management. Absorptive capability helps a firm focus on valuable information and increase the pertinence of obtaining external knowledge and decrease the time consuming on transfer activities. Knowledge assimilation is a process of analyzing, processing, explaining the acquired information and transforming the external knowledge into the firm. Huber holds the opinion that assimilation capability can improve the efficiency of knowledge explanation and reduce the waste of knowledge resources so that the firm can make cost down as a whole^[9]. Firms can combine the existing knowledge with the absorbed new knowledge and successfully shared inside the organization with knowledge transformation process. If a firm has good transformation capability, the cognitive level and satisfaction of knowledge in each department would be enhanced. Exploitation capability impels firms to be more sensitive to identify business opportunities, and then the firms can adjust the direction and speed of knowledge transferring according to market demand, which can increase exploiting efficiency. Therefore, we hypothesized that:

H2: Knowledge (1) acquiring, (2) assimilation, (3) transformation and (4) exploitation are positively related to knowledge transfer efficiency in firms.

Knowledge transfer efficiency and innovation performance

The knowledge which is necessary to innovation has circulated, shared and integrated inside and outside the organization because of knowledge transfer. However, not all transfer activities can promote technological innovations, only efficient knowledge transfer can provide firms with the lasting competence for innovation^[10]. The changes of general abilities of firms will promote its hardware conditions, incentive mechanism and culture learning. However, talking about the effect of knowledge transfer, it reflects on the changes of knowledge transfer efficiency^[11]. The enhancement of knowledge transfer efficiency can further reduce the cost of knowledge management; accelerate product development and commercialization; gain better market reaction to the product improvements and innovations. As a result, firms will realize the improvement of technological innovation performance^[12]. Therefore, we hypothesized that:

H3: knowledge transfer efficiency will be positively related to innovation performance.

Based on above studies, in the progress of technological innovation, knowledge absorptive capability belongs to higher-order abilities. In addition, transfer efficiency is the outward expression of general ability and technological innovation performance can reflect the final outcome of higher-order abilities' effects. In other words, absorptive capacity affects knowledge transfer efficiency by affecting the general ability of knowledge management, and the promotion of transfer efficiency will change the innovation performance. By discussing the relationships among the three and the theory of hierarchies of competence, we puts forward the conceptual model which was shown in Figure 1

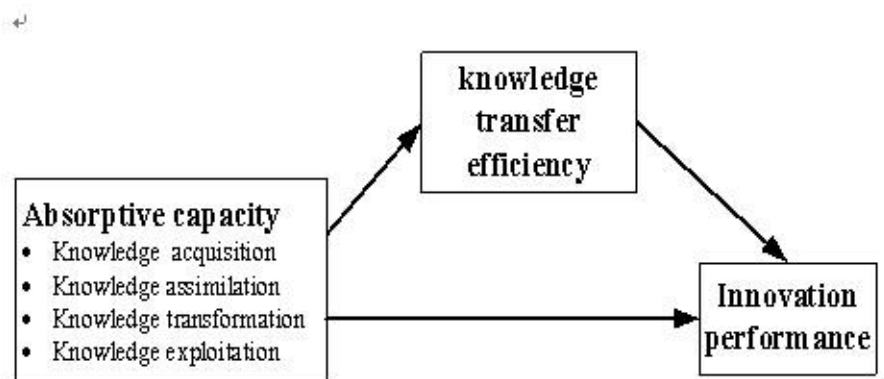


Figure 1 : Conceptual model

METHOD

Setting and data collection

The data in this article was collected by questionnaires. Cooperating with China Development Bank, we established sample firms from 7 provinces or cities in northeast and north China. They are mainly knowledge-intensive firms related to environmental governance, new energy, petroleum and chemical, mechanical manufacturing, bio-pharmaceuticals, etc. A total of 287 questionnaires were sent out and 231 were returned, corresponding with a response rate of 80.5%. Eliminating 14 invalid questionnaires, the effective ones were 217.

Measurement and validation of constructs

Each measure scale was applied using 5-point Likert scale, where 1 represent total disagreement and 5 represent total agreement.

For absorptive capacity, we adapted the measure of Jasen^[13]. absorptive capability was measured with acquisition capability (4 items), assimilation capability (3 items), transformation capability (4 items) and exploitation capability (4 items).

Innovation performance is measured with the instrument of Bell's^[14] and Ahuja's^[15]. It is composed by 4 items: the market reaction, the success rate compared with counterparts, the technical level and the number of patent exploitation.

Finally, knowledge transfer efficiency is measured with de scale of Gilbert's^[16], Kale's^[17] and Cummings^[18]. It is composed of 4 items: The time and the cost consumed on completing transfer activities, the satisfaction of the technology development caused by new knowledge absorbed in knowledge transfer; and the satisfaction for technology promotion and knowledge which are applied into production and service due to new knowledge absorbed in knowledge transfer.

ANALYSIS AND RESULTS

Measure validity and reliability

This study used the statistical software SPSS17.0 and AMOS17.0 as processing tools to test reliability and validity. Through examination of variables by analyzing exploratory factors, the results illustrate that KMO of the all variables are above 0.8 and the Bartlett Test of Sphericity values are significant at the level of 0.0000. After principal component analysis, each variable's factor loading under a single dimension is above 0.7; each component calculated by Cronbach's alpha coefficients is greater than 0.7; and all the component's accumulative contribution rates are over 50%. These results illustrates that the scale which is used in the study has a good reliability. All the variable scales came from the proven documentary indicators and were consulted and corrected by scholars and experts. Therefore, the questionnaires can be believed as having good content validity. The tests of convergent validity and discriminant validity adopted the methods of confirmatory factor analysis. Results in TABLE 1 can be seen that the whole indicators are on acceptable level. Thus, the questionnaires could be regarded as validity ones.

Result and path analysis

This study used structural equation to validate the model variables and path analysis. Through the conceptual model set by the overall fitness level test and the fit of the observation data, the fitted value and index are shown below: $\chi^2/df = 1.554$, $RMSEA = 0.046$, $NFI = 0.964$, $IFI = 0.960$, $TLI = 0.955$, $CFI = 0.949$. All the fitted values reach to acceptable levels. It illustrates that the goodness-of-fit of the structural equation model meet the requirement. Then test the significance level and function routes of absorptive capability among variables according to path coefficient, and those results are shown in TABLE 2. The table shows that all the hypothetical T-values and significance levels have up to standards. Therefore, the 9 hypothesis proposed in this paper have been supported.

TABLE 1 : Results of confirmatory factor analysis

Variables	χ^2/df	RMR	GFI	AGFI	IFI	CFI	RMSEA
Absorptive capacity	1.937	0.034	0.934	0.920	0.925	0.933	0.056
Knowledge transfer efficiency	1.852	0.033	0.937	0.909	0.931	0.923	0.061
Innovation performance	1.367	0.027	0.943	0.916	0.954	0.981	0.052

TABLE 2 : Results of hypotheses

	Path	Beta	T	P	Hypothesis
Knowledge acquisition	→ Innovation performance	0.146	2.63	**	H1a
Knowledge assimilation	→ Innovation performance	0.175	2.49	*	H1b
Knowledge ansformation	→ Innovation performance	0.286	2.75	**	H1c
Knowledge exploitation	→ Innovation performance	0.272	1.99	*	H1d
Knowledge acquisition	→ Knowledge transfer efficiency	0.251	2.03	**	H2a
Knowledge assimilation	→ Knowledge transfer efficiency	0.283	3.12	**	H2b
Knowledge transformation	→ Knowledge transfer efficiency	0.523	2.59	**	H2c
Knowledge exploitation	→ Knowledge transfer efficiency	0.517	2.17	*	H2d
Knowledge transfer efficiency	→ Innovation performance	0.624	3.01	**	H3

* $p < 0.05$, ** $p < 0.01$

Then the article moves forward to analysis on the effect coefficient which function routes of absorptive capability influenced innovation performance when transfer efficiency is taken as an intermediate variable. According to the data results in TABLE 3, one can recognize that the total effects of transformation and exploitation dimensions (0.612 and 0.595) are greater than the total effects of acquisition and assimilation (0.303 and 0.352). After that, we compare the direct effects of acquisition capability dimensions have on technological innovation performance. The path coefficients of acquisition and assimilation dimensions are relatively smaller (0.146 and 0.175). However, the other ones are relatively larger(0.286 and 0.272). The direct effects of absorptive capability have on acquisition efficiency also shows that the influences of knowledge acquisition and assimilation dimensions are relatively smaller (0.157 and 0.177) and the other two are larger (0.326 and 0.323). Besides, all the indirect effects are greater than direct effects.

TABLE 3 : Results of test of effects of mediation

	Path	Direct effects	Indirect effects	Total effects
Knowledge acquisition	→ Innovation performance	0.146	0.157	0.303
Knowledge assimilation	→ Innovation performance	0.175	0.177	0.352
Knowledge transformation	→ Innovation performance	0.286	0.326	0.612
Knowledge exploitation	→ Innovation performance	0.272	0.323	0.595

CONCLUSION

Absorptive capability (ACAP) influences technological innovation performance by changing the paths of general abilities. The results of path analysis show that each dimension of absorptive capability can affect knowledge transfer efficiency and innovation performance, but indirect effects are greater than direct effects. It proves that absorptive capability, which is a kind of higher-order ability, such as the knowledge managements. Therefore, improving general abilities will enhance the innovation performance.

The effects that RACAP promotes technological innovation performance by influencing knowledge transfer are more significant. Zahra points out that compared with potential absorptive capability (PACAP), RACAP makes a greater contribution to innovation performance. It means that the effects of transformation and exploitation capability are greater than acquisition and assimilation capability, yet Zahra has not given a further explanation to the reasons. The results of path analysis illustrates that the reason why RACAP and PACAP have different effects on technological innovation. They have different influences on knowledge transfer activities.

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