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RESEARCH ON THE MECHANISM OF UNIVERSITY-ENTERPRISE KNOWLEDGE TRANSFER ON ENTERPRISE INNOVATION PERFORMANCE

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Abstract. *In the era of information society, knowledge economy has been developed rapidly. So, the knowledge becomes a kind of important resources. Enterprise innovation performance has strong ties to knowledge acquisition. Based on the university-enterprise knowledge transfer, we constructed the structural equation model (SEM) of the influence of university-enterprise knowledge transfer on enterprise innovation performance from three dimensions of knowledge stickiness, knowledge source and knowledge transfer situation. On this basis, we use Amos22.0 to test correlation between various factors influencing innovation performance and the strength of important factors. Correlation analysis showed that there is a significant positive correlation between knowledge stickiness, knowledge source, knowledge transfer situation and innovation performance. Potential absorptive capacity is not involved or not directly involved in influencing innovation performance. In addition, the knowledge transfer situation has the greatest impact on innovation performance. The next is knowledge stickiness and knowledge source.*
Keywords: Knowledge transfer, University-enterprise knowledge transfer, Innovation performance, Potential absorptive capacity, SEM

1. **Research Background.** With the rapid development of science and information technology, high-tech industry has gradually become the fastest growing industry; in the meanwhile, competitive pressure has been increased. If enterprises want to win the market, innovation ability is especially important. On the one hand, the innovation of enterprises can hardly do without knowledge. On the other hand, a good academic environment of universities cannot exist independently without the rapid development of science and technology. Universities often cooperate and communicate with enterprises, sharing knowledge, talents and information they already have is an important way to give full play to their advantages. Universities and enterprises as the two main bodies of innovation, the cooperation among them can make up each other. By the way, it can also give full play to each other's innovation advantages, strengthen technological innovation and improve enterprise performance. This is of great significance to maximize their respective interests. The successful transfer of the knowledge between the two parties is the core issue of a win-win situation [1]. The idea of knowledge transfer was first put forward by Teece, who thought that enterprises have accumulated plenty of international application knowledge through international technology transfer [2]. The university-enterprise knowledge transfer is widely promoted abroad; however, in China, the university-enterprise knowledge transfer is not deep enough, and there is no unified definition of the university-enterprise knowledge transfer. According to the previous

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studies, the university-enterprise knowledge transfer has significantly improved the competitiveness of enterprises and the running level of universities. In the meanwhile, the university-enterprise knowledge transfer is also faced with some problems, including relatively single cooperation mode and imperfect cooperation system [3]. Corsten believed that university-enterprise knowledge transfer is a typical cross-domain knowledge transfer process of universities, scientific research institutions and economic fields in the filed of science [4]. Wu and Zhang pointed out that there are many difficulties in the process of knowledge transfer for enterprises with longer knowledge life cycle, higher ability of knowledge transfer and dissemination, and higher efficiency of knowledge absorption. However, improving the absorption efficiency can promote the efficiency of knowledge transfer [5]. The university-enterprise knowledge transfer process includes the starting stage, the action stage, the ending stage, and the establishment of a circular structure and system [6]. Because of the lack of systematic understanding of knowledge transfer, universities and business partners have a great difference between the concept of knowledge transfer and the expectation of knowledge transfer activities. Zeng et al. pointed out that university-enterprise knowledge transfer is an effective way for universities and research institutions to realize knowledge value; in the meanwhile, it is also an effective way for enterprises to acquire and accumulate knowledge [7]. Using the method of computational language, Woltmann and Alkærsig proved the direct connection between the published research reports of universities and the documents in enterprises and the information disclosed in corporate websites through the public text mining tool [8]. At present, the majority of scholars study the knowledge transfer within enterprises or between organizations, and some of them study international knowledge transfer. Few of them study the knowledge transfer between universities and enterprises. It is even rare to use empirical analysis to study the impact of university-enterprise knowledge transfer on enterprise innovation performance. This paper uses the method of equation modeling to empirically study the impact of university-enterprise knowledge transfer on enterprise innovation performance. Enrich the basis theory of university-enterprise knowledge transfer and it is of great significance to improve efficiency of knowledge transfer between universities and enterprises, and the innovation performance of enterprises.

2. Research Hypothesis and Theoretical Model.

On the basis of previous research, through the literature analysis of university-enterprise knowledge transfer and innovation performance at home and abroad, we divided the dimensions of university-enterprise knowledge transfer and innovation performance. This paper comprehensively selects three aspects as the dimensions that affect university-enterprise knowledge transfer, including knowledge stickiness, knowledge source and knowledge transfer situation in knowledge characteristics. Besides, innovation performance includes technical innovation, management innovation and institutional innovation. Furthermore, potential absorptive capacity contains two dimensions of knowledge acquisition and knowledge digestion.

2.1. Potential absorptive capacity and university-enterprise knowledge transfer.

Etzkowitz regarded university-enterprise knowledge transfer as the "second revolution" of universities and pointed out that part of the mission of universities is to promote economics and social development [9]. On the other hand, some scholars believe that knowledge transfer is a one-way communication of skills, information and abilities between universities and industry through cooperation projects. Besides, in the context of university-enterprise cooperation, Aziati et al. defined knowledge transfer as the activity which is designed to transfer knowledge, skills or technology. These activities can help the industry or academic institutions (depending on the direction of transfer) further develop its activities [10]. The stronger the learning ability, the stronger potential absorptive capacity, and the less the interference of the affected factors. Wu and Yang through the

research on the influencing factors of knowledge transfer in industry-university-research cooperation innovation pointed out that knowledge transfer process is affected by knowledge stickiness, knowledge source and knowledge transfer situation. Among them, knowledge stickiness is mainly embodied in complexity, expressiveness and embeddedness. The willingness to transfer knowledge and ability to transfer knowledge in knowledge source will affect the effect of knowledge transfer. Trust and communication in the context of knowledge transfer are important conditions to promote the occurrence of knowledge transfer [11]. Based on the above analysis, the following hypotheses are proposed.

H1: There is a positive correlation between knowledge stickiness and potential absorptive capacity.

H2: There is a positive correlation between knowledge source and potential absorptive capacity.

H3: There is a positive correlation between knowledge transfer situation and potential absorptive capacity.

2.2. **Innovation performance and university-enterprise knowledge transfer.** The authors summarize the viewpoint from the literature that most domestic scholars believe that innovation performance is to absorb new knowledge and increase the output or business volume of enterprises after using new technologies. In turn, it will drive economic development. Thornhill, a foreign scholar, believes that innovation performance is related to company's scale and technical system. Innovation bahavior often exists in enterprises with high R&D intensity. And enterprise knowledge, industry dynamics and innovation interaction will affect innovation performance together [12]. Above all, innovation performance is the increase of business volume of enterprises or output after absorbing new knowledge of universities or new knowledge of enterprises. As we know, the research of enterprises requires new knowledge and new discoveries, universities as the main source of new knowledge, university-enterprise knowledge transfer plays the non-neglectable role in enterprise innovation performance. Based on the above analysis, we put forward the following assumptions.

H4: There is a positive correlation between knowledge stickiness and innovation performance.

H5: There is a positive correlation between knowledge source and innovation performance.

H6: There is a positive correlation between knowledge transfer situation and innovation performance.

2.3. **Potential absorptive capacity and innovation performance.** Zahra and George think that potential absorptive capacity will positively influence the flexibility of resource allocation [13]. On the one hand, the stronger the potential absorptive capacity, the stronger the ability to acquire external knowledge. On the other hand, potential absorptive capacity can also affect the ability to internal knowledge exchange. In the meantime, the enhancement of the ability to acquire external knowledge and internal knowledge exchange stimulates the generation of innovation results and improves innovation performance. Most of the scholars analyze innovation performance usually from the perspective of technological innovation. However, management innovation and institutional innovation also have a certain impact on innovation performance. So, the description of innovation performance in this paper includes three aspects, and there are technological innovation, management innovation and institutional innovation. Based on the above contents, this paper proposes the following assumption.

H7: There is a positive correlation between potential absorptive capacity and innovation performance.

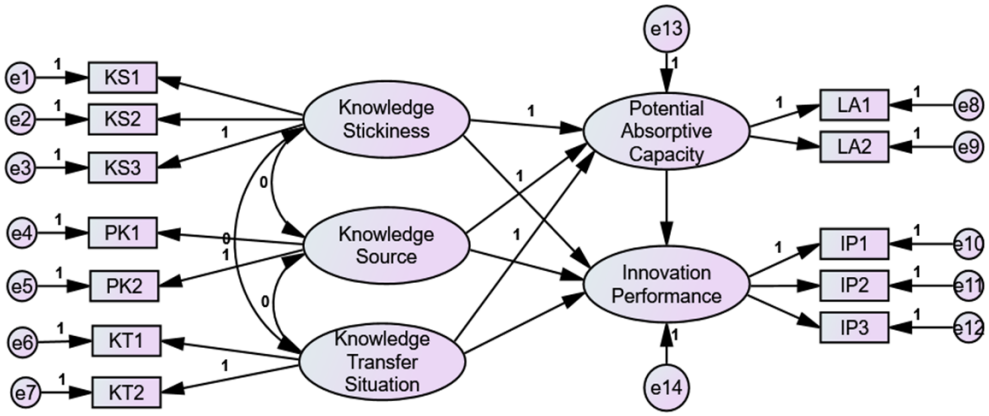

FIGURE 1. Theoretical model

2.4. **Theoretical model.** Based on the above assumptions, we come up with the theoretical model of this study (see Figure 1).

From the whole framework of the model, we can see that the model has three exogenous latent variables, two endogenous latent variables and twelve observable variables. In addition, there also have fourteen residual variables. As we can know, residual variables ensure that the test process of the model can be established. Besides, KS1 in this model is for complexity, KS2 is for expressibility, KS3 is for embeddedness, PK1 is for willingness to transfer knowledge, PK2 is for ability to transfer knowledge, KT1 is for trust, KT2 is for communication, LA1 is for knowledge acquisition, LA2 is for knowledge digestion, IP1 is for technological innovation, IP2 is for management innovation, and IP3 is for institutional innovation. This model not only depicts function routes of different homogeneous surface to potential absorptive capacity and innovation performance, but also depicts function routes of potential absorptive capacity to innovation performance. The research conducts an empirical study based on the above theoretical model.

3. Research Design.

3.1. **Data sources.** The research in this article adopted questionnaire survey to collect the necessary statistics. According to literature research and interviews, the questions raised by the questionnaire were identified, and the preliminary draft of the questionnaire was formed. The final draft of the questionnaire was formed through small-scale trial and revision. The questionnaire was designed by a Likert 5 subscale, and Likert 5 subscale has five alternative answers, which are completely inconsistent, not consistent, general, consistent and completely consistent. Then, the questionnaire will be distributed to knowledge workers in the five representative enterprises we selected. Questionnaires will be distributed on-site distribution, e-mail and QQ. Filling the questionnaire is confidential and anonymous so that people who fill the questionnaire do not need to worry about anything. A total of 263 questionnaires were issued and 248 questionnaires were recovered. Among these questionnaires, there include 223 valid questionnaires. And the effective questionnaire recovery rate was 84.7%. Then the results were analyzed with SPSS20.0 for reliability analysis and exploratory factor analysis.

3.2. **Reliability test.** The investigation items of this study were selected from previous studies and in the next step of the research, we will modify the research samples to form a new research scale. However, because the research did not conduct multiple repeated measurement, we adopted Cronbach's coefficient reflecting internal consistency to test the reliability of the five latent variables of the conceptual model. In general, the larger the Cronbach's coefficient is, the higher the internal consistency will be. If the Cronbach's coefficient is greater than 0.9, it will be indicated that the reliability is very good. If

Cronbach's coefficient bound is between 0.8 and 0.9, it will be indicated that the reliability is good. If Cronbach's coefficient is between 0.7 and 0.8, it will be indicated that the reliability can be acceptable. And if Cronbach's coefficient is less than 0.7, it will be indicated that the reliability is in an unacceptable range. Through SPSS20.0, we calculate the internal consistency of data. As we can see, Cronbach's coefficient of the whole scale is 0.861, it shows that the scale has a good credibility and the internal consistency is very high, as is shown in Table 1. And the Cronbach's coefficient of each latent variable is shown in Table 2. The Cronbach's value is all greater than 0.7 and the reliability can be acceptable.

Table 1. Overall scale reliability statistics

Cronbach's Alpha	Cronbach's Alpha based on standardized items	Number of items
.861	.857	12

Table 2. Reliability value of each latent variable

Latent variable	Cronbach's Alpha
Knowledge stickiness	0.817
Knowledge source	0.711
Knowledge transfer situation	0.726
Potential absorptive capacity	0.803
Innovation performance	0.779

3.3. **Validity test.** Validity can be divided into two aspects: content validity and structural validity. Due to the fact that the items and measurement scales of this study were all selected from previous studies, we modified the research samples later. So, under some condition, the effectiveness of the content ought to be evaluated after the argumentation of some researchers and practical experts. Then we will through expert judgement review, delete and modify items to ensure good content validity to a certain extent. This research uses structural validity, and structural validity can also be called construct validity or theoretical validity. Based on this, verify whether the designed variables are suitable for the structural equation model of this paper. And the structural validity is evaluated by the model coefficients. Moreover, in this research, χ^2/df, CFI, NFI, IFI, RMSEA indicators were used for measurement. If the model fits well, the indicators are between 1-3, CFI, NFI, IFI are greater than 0.9, and the closer these three indicators are to one, it will be better. RMSEA should be less than 0.5. The index of each index obtained through AMOS is shown in Table 3. We can know that the fitting degree of each index is better, so it has a better structural validity.

Table 3. The fitting index of each indicator

Fitting index	χ^2/df	CFI	NFI	IFI	RMSEA
Knowledge stickiness	2.341	0.969	0.914	0.969	0.069
Knowledge source	2.835	0.901	0.931	0.915	0.129
Knowledge transfer situation	2.298	0.953	0.979	0.920	0.161
Potential absorptive capacity	1.405	0.939	0.964	0.947	0.082
Innovation performance	2.410	0.948	0.981	0.956	0.047

3.4. **Analysis of model data and correction model.** The research of this paper uses Amos22.0 to establish the structural equation model to verify the mechanism of university-industry knowledge transfer on enterprise innovation performance. First of all, the data was verified, including the fitting degree of the model, as is shown in Table 4.

TABLE 4. The fitting test of the model of the influence of university-industry knowledge transfer on innovation performance

Fitting index	χ^2/df	CFI	NFI	IFI	RMSEA
Ideal value	1-3	> 0.9	> 0.9	> 0.9	< 0.5
Hypothetical model	5.126	0.911	0.840	0.908	0.36

As can be seen in Table 4, the chi-square value of the model is relatively large, while the standard fitting index is relatively small. So, further corrections are required. Modification indices (MI) are provided by Amos22.0. Through this index, we modified the model in the next step. And the final model fitting index is shown in Table 5. It can be seen from Table 5 that the fitting degree of the modified model is acceptable.

TABLE 5. Modified model fitting index

Fitting index	χ^2/df	CFI	NFI	IFI	RMSEA
Result	2.86	0.935	0.902	0.913	0.41

3.5. **Resutlts.** In Amos22.0, we will use the modified structural model to test the influence of various factors on innovation performance. Finally, the corrected structural equation model is shown in Figure 2. The path system estimation coefficients of the model are shown in Table 6.

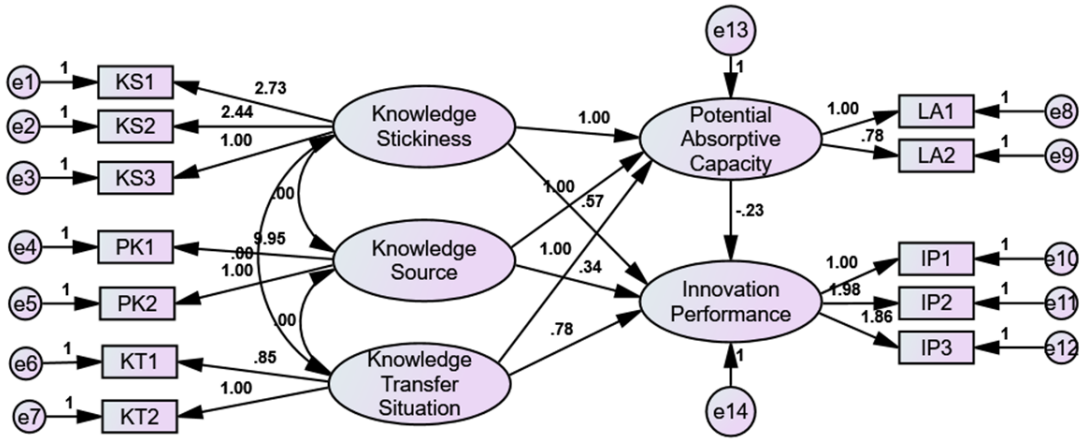

FIGURE 2. Revised theoretical model

The following points can be seen from the path system estimation table. First, the standardized path coefficient of knowledge stickiness and potential absorptive capacity is 0.509. Second, the standardized path coefficient of knowledge source and potential absorptive capacity is 0.531. Third, the standardized path coefficient of knowledge transfer situation and potential absorptive capacity is 0.467. Moreover, the P value shows that all three paths have passed the significance test, which supports Hypotheses H1, H2, H3 of this study. On the other hand, the standardized path coefficient of knowledge stickiness and innovation performance is 0.574. The standardized path coefficient of knowledge source and innovation performance is 0.340. The standardized path coefficient of knowledge transfer situation and innovation performance is 0.779. In addition, the P value also

TABLE 6. Path system estimation of the influence of university-industry knowledge transfer on innovation performance model

Path relationship	Standardized coefficients	S.E.	C.R.	P
Potential absorptive capacity ← Knowledge stickiness	0.509	0.044	11.618	⁂
Potential absorptive capacity ← Knowledge source	0.531	0.049	10.907	⁂
Potential absorptive capacity ← Knowledge transfer situation	0.467	0.036	13.036	⁂
Innovation performance ← Knowledge stickiness	0.574	0.016	8.821	⁂
Innovation performance ← Knowledge source	0.340	0.024	6.783	⁂
Innovation performance ← Knowledge transfer situation	0.779	0.067	7.580	⁂
Innovation performance ← Potential absorptive capacity	−0.225	0.034	−6.760	0.157

Note: ⁂ indicates that 0.01 level is significance. The C.R. is the value of t.

shows that all three paths have passed the significance test, thus supporting Hypotheses H4, H5, H6 of this study. Last but not least, the path coefficient between potential absorptive capacity and innovation performance is -0.225, and $P = 0.157 > 0.05$, so the positive correlation between potential absorptive capacity and innovation performance is not supported. It indicates that potential absorptive capacity is not involved or not directly involved in influencing innovation performance. In addition, it can also be obtained from the various standardized path coefficients that knowledge transfer situation has the greatest impact on innovation performance.

4. **Conclusions.** This paper analyzes the factors which affect innovation performance by constructing the structural equation model of the impact of university-enterprise knowledge transfer on innovation performance. The analysis shows that there is a significant positive correlation between knowledge stickiness, knowledge source, knowledge transfer situation and innovation performance. Potential absorptive capacity is not involved or not directly involved in influencing innovation performance. In addition, among all the influencing factors, knowledge transfer situation has the greatest impact on innovation performance. The next is knowledge stickiness and knowledge source. Although most of the hypotheses in this study have been validated, due to the insufficiency of the sample size survey, the limitation is still obvious compared with the large sample size. In the meanwhile, enterprises and investigators have some limitations. In this study, only 263 employees of five representative enterprises were surveyed. In the follow-up study, more people can be surveyed to collect data and enhance the universality of the study.

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