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S&T Collaboration Platform for Higher Education Institutions and Industry: a Case Study of Wenzhou, China

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Collaboration between higher education institutions and industry seems to have become increasingly important for the industrialized countries. To realize the maximized profits through such collaborations, it is important to have a fruitful and healthy collaboration. S&T collaboration platform in Wenzhou, China, is a new fashioned form. This paper analyzes the collaboration relationship and explores the influence of collaboration on private SMEs. Based on a survey of 523 private SMEs and 61 higher education institutions, the results indicate that private SMEs can improve economic performance through the collaborations with higher education institutions on the platform. Furthermore, the economic performance of private SMEs is positively related with the collaborated projects. In other words, the number of the collaboration projects is one of the factors that affect the economic performance (i.e. the more collaboration, the better economic performance). The results have also revealed that SMEs that choose different collaboration models on the platform will produce different effects on the economic performances of enterprises. In addition, the major barriers to the collaboration have been analyzed from two perspectives in this study. Among all the collaboration barriers between universities and private SMEs, "Lack of efficient communication channel" and "Unreasonable transfer cost for the R&D achievements of universities" have been identified as the most important factors. Meanwhile, the performances of the five communication mechanisms (i.e. coordination mechanism, supervision mechanism, transmission mechanism, propaganda mechanism and guarantee mechanism) have also been examined with the aim of devising policies and proposing a possible solution to improve the collaboration efficiency between higher education institutions and industry.

Keywords: *Higher education institutions-Industry collaboration, S&T collaboration platform, Higher education institutions, Universities, Communication mechanisms.*

Introduction

Collaboration between industry and higher education institutions plays an increasingly important role in the economic development of European countries as well as in China, a new industrialized country (Guan & Brockhoff, 1994). In the new industrialized countries, particularly, as the economy and technological capabilities improve, higher education institutions are expected to play a role in supporting indigenous enterprises towards a move into more dynamic industries (Mathews & Hu, 2007; Mazzoleni & Nelson, 2007; Wu, 2007). In today's highly competitive environment, the ability to keep up with technological progress and continuous innovation is vital for the survival and growth of an enterprise. Nonetheless, it is very difficult for enterprises, especially for SMEs, to develop new technologies and entirely rely on their own capabilities; this is due largely to the limited expertise and resources (Sungjoo & Gwangman, 2010). Motohashi (2005) finds that SMEs which are active in high-technology sectors achieve higher productivity via higher education institution-industry collaboration.

There is widespread recognition that collaboration between higher education institutions and industry should be strengthened and improved in order to meet the growing demand for enterprise development (Richard *et al.*, 2005). According to Li (2000), collaboration between industry and higher education institutions is helpful to reduce the cost of R&D as well as the risks, and promoting the higher education institutions and enterprises to share resources and achieve complementary capability. Through the collaboration with higher education institutions, enterprises can also reduce uncertainty from the innovation process, expand markets, as well as gain new expertise and skills, which will in turn allow them to keep up with the development of scientific knowledge (Hagedoorn *et al.*, 2000; Lee, 2000; Fritsch & Lukas, 2001). For most countries, such collaborations have become more and more important to the economic development of the area. For instance, the number of such collaboration in Canada has increased twice from 1980 to 1995 (Godin & Gingrasr, 2000).

In the past few years, Chinese R&D expenditure has raised significantly. Table 1 implies that, although China is still behind some major developed countries in the amount of R&D expenditure, China enjoys the highest increasing speed from the year 2002 to 2009. Different from developed countries, China has different institutions. Therefore, the technology innovation force is in the higher education institutions rather than in the industry. As can be seen from Table 2, R&D expenditure of Chinese higher education institutions shows a growth trend, increasing

from 7.67 billion RMB in 2000 to 59.73 billion RMB in 2010, an increase of nearly 8 times within 11 years. Chinese higher education institutions conduct both basic research and applied research. Table 2 indicates that the expenditure supporting applied research is larger than that supporting basic research and testing research. This trend becomes more and more obvious in recent years. In 2010, the applied research expenditure has accounted 56.4 % of the total, which indicates the emphasis of the applied research in China. According to Dasgupta and Paul (1994), higher education institutions are primarily driven to create new knowledge and to provide education, while, private enterprises are focused on capturing valuable knowledge that can be leveraged for competitive advantages. However, higher education institutions today should take more responsibilities to transfer S&T achievements to the industry in answer to the rapid market demands (Spyros *et al*., 2008).

Table 1

R&D information of six countries

Country	R&D Expenditure/GDP (%)		The Average Annual Rate of Growth (%)
	2002	2009	
China	1.07	1.70	24.02
USA	2.66	2.90	6.59
Japan	3.17	3.36	2.04
UK	1.82	1.86	4.48
France	2.23	2.26	3.20
Germany	2.49	2.82	3.34

Source: China Statistical Yearbook on Science and Technology (2011)

Table 2

Distribution of higher education institutions R&D expenditure

Year	R&D Expenditure (% of GDP)	Basic research	Applied research	Testing &Development
2000	7.67 (0.077)	1.78	4.00	1.89
2001	10.24 (0.093)	1.90	5.66	2.68
2002	13.05 (0.108)	2.78	6.71	3.56
2003	16.23 (0.120)	3.29	8.97	3.97
2004	20.09 (0.126)	4.79	10.88	4.42
2005	24.23 (0.131)	5.67	12.50	6.06
2006	27.68 (0.128)	7.14	13.73	6.82
2007	31.47 (0.118)	8.68	16.18	6.61
2008	39.02 (0.124)	11.48	20.89	6.65
2009	46.82 (0.137)	14.55	25.00	7.26
2010	59.73 (0.150)	17.99	33.70	8.03

Source：China Statistical Yearbook on Science and Technology (2011) Unit: Billion RMB

In fact, most countries have tried their best to promote and strengthen the collaboration between industry and higher education institutions (Etzkowitz & Leydesdorff, 2000). Accordingly, a large number of researchers coming from different countries have paid great attention on this research. Hall *et al.,* (2001) reveal and analyze barriers inhibiting industry from collaborating with higher education institutions. Bruneel *et al.,* (2010), investigate the factors which diminish the barriers to the collaboration between industry and higher education institutions. Rees (1991) also suggests that there is great potential for many countries to increase collaborations between industry and higher education institutions.

Although the collaboration between higher education institutions and industry is conducive to reducing the cost of R&D, decentralizing risks, and making these organizations share resources, most researchers agree that because of the lack of direct connections between higher education institutions and industry on a lot of R&D projects, the economic return for most collaborated projects is unsatisfactory. According to the statistics, in China, about 85 % of R&D projects aiming at industrial production fail to make it to the market.

In China, the government has made great efforts to encourage universities and enterprises to enhance the collaboration to meet the growing market demand, such as the S&T collaboration platform of Wenzhou, China. Meanwhile, more and more Chinese enterprises begin to increase the higher education institution-industry collaborations, and these collaborations accordingly will create a great impact on the development of the enterprise. This paper, with special reference to Wenzhou, China, explores the influence of higher education institution-industry collaborations on the SMEs in China.

In order to examine the effect of the collaboration, this paper proposes the two following hypotheses:

H1: Private SMEs can improve economic performance through the collaboration on the platform.

H2: Different collaboration models will bring about different economic performances on SMEs.

The five collaboration models on the platform are also discussed in this paper as well as the major barriers to the collaborations and the five communication mechanisms are examined in order to propose suggestions to improve the collaboration efficiency.

Methodology

Wenzhou, the cradle of the market economy in China and representative of the barometer of private investment, is well-known for its intensive and prosperous SMEs (Guo & Liu, 2002; Alan & Liu, 1992). Table 3 shows that

private SMEs increase almost six times from 2000 to 2011, and the number of investors and registration monetary has risen sharply. In 2011, the total amount of SMEs has reached more than 300,000. According to statistic year books, private SMEs in Wenzhou have produced 10 % of the total clothing, 20 % of the total shoes, 60 % of the total razor, 65 % of the locks, 80% of the glasses, 90 % of the metal lighter and 90 % of the watercolor pens for China. Low-voltage electrical equipments, hardware, auto parts, ceramic products also occupy a remarkable market share. Accordingly, Wenzhou is the most active private economic city. Therefore, this study takes Wenzhou as a sample.

A survey of Chinese manufacturing industries in Wenzhou was conducted in 2009. With the help of Wenzhou Science and Technology Bureau, questionnaires were sent to 680 private SMEs, 69 universities and other types of institutes including technical secondary schools, junior colleges, vocational technical institutes, etc. in Wenzhou Area (see Table 4). People surveyed were working in the enterprise related departments or at the technology transfer office of higher education institutions. They participated and answered a questionnaire about their innovation and collaboration situation from 2006 to 2008.

Before the mass survey, pilot tests were conducted in some enterprises. According to their feedback, the questionnaire was revised to improve its clarity. As a result of mass survey, the response rates were relatively higher than most similar studies in Western countries with 89.1 % and 94.2 % for private SMEs and higher education institutions respectively. Our corresponding effective response rates are 86.3 % and 93.8 %.

There are numerous measurement methods about economic performance indicators of SMEs. In this paper, the SMEs' economic performance is measured by the average sales per person and the average profits per person.

Table 3

Distribution of private SMEs in Wenzhou

Year	Number of private SMEs	Number of investors	Employed persons	Registration funds (ten thousand RMB)	Gross output value (ten thousand RMB)
2000	13077	38540	134414	1365548	
2001	27068	93002	329176	3006894	
2002	28430	86078	276126	3441419	
2003	34975	103187	364974	4105714	
2004	38635	110991	409331	4667859	
2005	40682	113145	369922	6655048	8095355
2006	46102	130244	375709		8946711
2007	50317	140772	769593		9155283
2008	58844	143191	814089		
2009	60327	158082	656924		
2010	73562	172268	852689	19866857	
2011	81162	196565	893265	24682856	

Source: Wenzhou Statistical Yearbook (2011)

Table 4

Distribution of higher education institutions in Wenzhou

Type	Number	Name
University	16	Tsinghua University, Zhejiang University, Tianjin University, Wenzhou University, Harbin Institute of Technology, Northwestern Polytechnical University …
Technical Secondary School & Junior College	23	Wenzhou Radio & Television College, Zhejiang DongFang Vocational & Technical College, Wenzhou University Oujiang College …
Vocational Technical Institute	30	Wenzhou Vocational & Technical College, Zhejiang Industry & Trade Vocational College, Wenzhou University City College …

Significance of S&T Collaboration Platform for Higher Education Institutions and Private SMEs

Most researchers suggest that the best choice for private SMEs to promote innovation is to establish collaborations with higher education institutions, and this method has become more and more attractive (Li, 2000). Table 5 shows that in China, the funds for higher education institutions usually come from government support or enterprises investment. From 2003 to 2010, financial support from government is higher than that from enterprises. But the funds from enterprises have increased year by year, and have reached 19.85 billion RMB, which indicates a frequent and benignly collaboration between SMEs and higher education institutions. Table 6 shows that the expenditures purchasing domestic R&D achievements was 22.14 billion RMB, 1,810 patents were transferred from higher education institutions, and the turnover to higher education institutions was as high as 359.43 million RMB, which means that R&D collaboration can benefit both enterprises and higher education institutions and this becomes a win-win technology innovation policy (Hill & Brennan, 2000). Table 6 also shows that the amount of R&D achievements transferred is much larger than the total amount in the central and western areas in China. This is due largely to the imbalanced economic development. In China, the economy of eastern coastal cities is prosperous and dynamic because a large number of SMEs are developed there, among all of which, Wenzhou is a typical representative. In this regard, we choose Wenzhou as a case study to investigate the characteristics of the collaboration platforms.

Table 5

Sources of R&D funds in higher education institutions

Source of R&D funds in higher education institutions	2003	2004	2005	2006	2007	2008	2009	2010
Enterprises funds	5.83	7.45	8.89	10.12	11.03	13.49	17.17	19.85
Government funds	8.77	10.88	13.31	15.15	17.77	22.55	26.22	35.88

Source: China Statistical Yearbook on Science and Technology (2011); Unit: Billion RMB

Table 6

Data of collaboration between SMEs and higher education institutions

	Expenditures purchasing domestic R&D achievements （billion RMB）	Patents transferred from universities （item）	Turnover of Patents Transferred (million RMB)
China	22.14	1810	359.43
Eastern China	10.78	1062	255.85
Middle China	2.37	424	53.39
Western China	8.99	324	50.18

Source: China Statistical Yearbook on Science and Technology (2011)

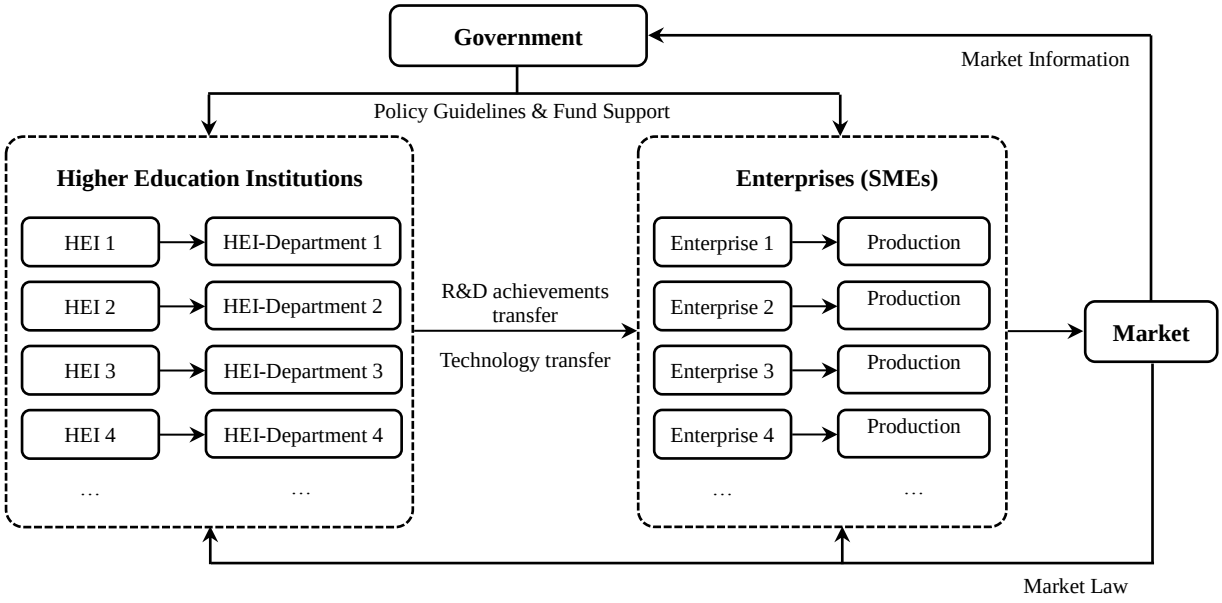
Collaboration Platforms of Higher Education Institutions

According to statistics, there are many collaboration forms between SMEs and higher education institutions in China, such as the , the directly contact between SMEs and higher education institutions, collaboration led by local government, R&D achievement transaction by social agents, collaboration platforms of higher education institution, etc. The first three forms are all relatively traditional collaboration forms. Although they prevail for a long time, there are still some shortages.

In China, the collaboration platform conducts R&D achievements transfer between SMEs and higher education institutions. Its function is similar to technology transfer offices of universities in western countries. However, compared with technology transfer offices, collaboration platform has the government support.

Technology transfer office is a common form of S&T achievements transfer in higher education institutions in the USA (Dylan & Magnus, 1999). Currently, there are more than 200 universities that have established their own R&D achievements transfer office in the USA; since 1985, British technology group has lost their monopoly control to the knowledge patents, and then many universities began to set up technology management organizations to promote R&D achievements transfer. In China, more and more higher education institutions begin to set up their own collaboration platform. Lots of top universities in China set up R&D achievements transfer office in Wenzhou, such as Tsinghua University, Zhejiang University, Harbin Institute of technology, etc.

Compared with the traditional collaboration forms, platform takes some advantages. Characteristics of this S&T achievements transfer will be analyzed through the case studies in Wenzhou. The relationship between higher education institutions, SMEs and local government can be represented in Figure 1.



Remarks: HEI-Department 1 = Wenzhou technology transfer department of Higher education institution 1, etc.

Figure 1. The framework of S&T collaboration platform for private SMEs and Higher education institutions in Wenzhou

This framework reflects the real connections of S&T collaboration platform between private SMEs and higher education institutions in Wenzhou. The framework encompasses both the relationship within the collaboration and the role of government. On the one hand, higher education institutions transfer their R&D achievements and technologies, which are mainly financially supported and guided by government, to enterprises. On the other hand, SMEs rely on both R&D achievements and technology from higher education institutions as well as on their own in-house R&D. In addition, the government also plays an intermediate role in the whole process. Local government provides supporting measures for the collaboration platform, such as offices for higher education institutions and arrangements for their employees' accommodation in Wenzhou. With the help of this platform, private SMEs can seek partnership with any higher education institutions, and each higher education institution can look for collaboration with any private SMEs. Higher education institution offices are windows to SMEs and will always be regarded as "a small collaboration platform" to sell its R&D achievements. Meanwhile, the related departments of higher education institutions which include R&D achievement transfer office, industrial research laboratory, S&T achievement commercialization department, etc. are all involved in the R&D achievement and technology transfer.Obviously, the collaboration platform is a complicated network rather than a simple linear structure, which endows more choices and flexibility to both private SMEs and higher education institutions because both parties can choose proper themes to collaborate in accordance with their own special condition. In addition, private SMEs and higher education institutions can cooperate with multi-entities involved on this platform, through which the efficiency has been improved significantly. R&D achievement commercialization is realized on this platform. Higher education institutions take full advantage of their science and technology strength to develop new technologies, transfer these new technology to the collaboration platform and then private SMEs add commercialized value to these technologies, using advanced technology to product, thus a commercialization process is completed (Motohashi & Kazuyuki, 2005). Furthermore, when these products enter the marketplace, accordingly, the related market information (for example, technology novelty, customer satisfaction, economic performance of the products, etc.) is fed back to the related government departments. That will help government make the policies and suggestions for further collaborations. Meanwhile, the market performance (including the market demand of the new product and the customer satisfaction) is also fed back to the higher education institutions and enterprises. Based on this information, SMEs and higher education institutions will make their own decision respectively for the current transfer as well as for further collaborations.

On the collaboration platform, five collaboration models and major barriers to the collaborations are examined in this study with the purpose to make policies and suggestions to improve the collaboration efficiency.

Analysis of Economic Performance of Collaboration on the Platform

In order to test hypothesis *H1*: "Private SMEs can improve economic performance through the collaborations with higher education institutions on the platform", the private SMEs were divided into the following two groups: enterprises with collaborations and enterprises without collaborations. To guarantee that the two groups are identical except for the collaboration conditions, a stratification and random sampling technique was used in this survey. (In addition, these data were derived from the pilot tests). Meanwhile, an independent sample T-test was used between the two groups. J_1 represented the average sales per person and J_2 the average profits per person. J_1 and J_2 were used as economic performance indicators of SMEs.

Table 7

Comparison of economic performances for the two groups of enterprises by T-test

Performance	Group with collaboration	Group without collaboration	T-value	Significance
Average sale per person (J_1)	231.62	184.68	2.142	S (0.044)
Average profit per person (J_2)	24.48	20.65	2.109	S (0.047)

Unit: Thousand Yuan in RMB

The results in Table 7 show that there are significant differences in respect to both J_1 and J_2 between the two groups. Also, the figures of J_1 and J_2 for the group with collaboration are higher than those without collaborations. It indicates that the economic performances of the enterprises with collaborations are better than those without collaborations, and there are significant differences between them in the statistical terms. Consequently, the results support Hypothesis 1. The analysis result is expected to be in accord with the purpose of the collaborations.

Hypothesis 1 ("Private SMEs can improve economic performance through the collaborations on the platform") is proposed on the basis of the expectation that the collaborations with higher education institutions could improve the development of enterprises and bring significant influence on economic performance. In other words, Hypothesis 1 is equal to the fact that the more collaborations between higher education institutions and private SMEs, the better economic performance of enterprises.

The correlation coefficients between collaborated projects and economic performance are calculated and the results are shown in Table 8.

The results imply that there is significant correlation between all the indicators (i.e. the number of the collaborated projects, J_1 the average sales per person and J_2 the average profits per person) for collaborated projects

and economic performance. It can also be found that economic performance is positively correlated with the collaborated projects. This finding is consistent with the results in Table 7, where economic performances of the enterprises with collaborations are better than those of the enterprises without collaborations. Accordingly, the result again supports the Hypothesis 1.

Table 8

Pearson correlation analysis between collaborated projects and economic performances

Economic performance	Pearson Correlation Coefficients	S/NS
J_1	0.380*	S
J_2	0.260*	S

The values in the table are correlation coefficients (p-values).
**. Correlation is significant at the 0.05 level (two-tailed).*

Analysis of Collaboration Models and Barriers of Collaboration Platforms

Distribution of Collaboration Models

On the collaboration platform for the private SMEs and higher education institutions, the five collaboration models are identified as follows (Peter & Fusfeld, 1982):

(1) MODEL I: SMEs purchase R&D achievements directly from higher education institutions;

(2) MODEL II: SMEs develop R&D achievements in collaboration with higher education institutions;

(3) MODEL III: SMEs entrust R&D tasks to higher education institutions;

(4) MODEL IV: SMEs establish R&D organizations with higher education institutions;

(5) MODEL V: SMEs employ technological personnel from higher education institutions.

Table 9 shows the respective choices that private SMEs and higher education institutions hold towards these five collaboration models. All the private SMEs and higher education institutions surveyed have had collaborations on the platform. In order to compare the economic performances of the five collaboration models respectively, this paper selects some special enterprises as the study object. These enterprises only chose one collaboration model. Therefore, seen from the perspectives of two subjects of the collaboration platform, the results indicate the differences as well as pros and cons of these five models.

Table 9

Distribution of different collaboration models

Model	Private SMEs (N = 523)		Higher education institutions (N = 61)	
	Number (%)	Ranking	Number (%)	Ranking
MODEL I	99 (19%)	3	9 (14.8%)	4
MODEL II	198 (37.9%)	1	23 (37.7%)	1
MODEL III	38 (7.3%)	4	4 (6.6%)	5
MODEL IV	16 (3%)	5	10 (16.4%)	3
MODEL V	146 (28%)	2	12 (19.7%)	2

From the perspective of private SMEs, MODEL IV ranks last among all the models because most private SMEs are not capable of setting up R&D organizations with higher education institutions due to the limitation of capital and scale, Furthermore, few enterprises choose MODEL I or MODEL III with 19 % and 7.3 % respectively in the overall proportion because on one hand, the lack of relevant information and effective communication makes it difficult for the enterprises in China to directly absorb and commercialize technology developed by higher education institutions; on the other hand, the research in the Chinese higher education institutions mainly focuses on the theory other than the practical experience. Therefore, the R&D achievements are rather knowledge-oriented than market-oriented. As a result, the enterprises can't guarantee the market value of the achievements even if they purchase R&D achievements directly from higher education institutions or entrust tasks to higher education institutions.

From the perspective of higher education institutions, MODEL III accounts for the least proportion among all with only 6.6 %. Different from enterprises, higher education institutions focus on the technology itself and pay little attention to the actual application and market efficiency in their research and development. If entrusted by the enterprises to be fully responsible for the technology research and development, the higher education institutions are unable to ensure whether their achievements will meet the needs of the enterprises and achieve the expected market objectives. Therefore, there are some difficulties in adopting this model. Meanwhile, similar to that of private SMEs, universities seldom choose MODEL I, with the proportion accounting for 14.8 %.

It can be seen from Table 9 that most private SMEs and higher education institutions show preference to MODEL II, with 37.9 % and 37.7 % respectively. In this collaboration model, the objectives of enterprises as well as higher education institutions are identical, including both technological concerns and market concerns. In addition, both sides of the cooperation can realize mutual complements in resources on their own superiority (Mansfield & Lee, 1996). Furthermore, MODEL II represents a process of two-way learning and two-way benefits (Bougrain & Haudeville, 2002).

In order to test hypothesis *H2*: "Different collaboration models will bring about different economic performances on SMEs", ANOVA is used in this paper. In addition, Profit Growth Rate per Person is used as the indicator of economic performance of private SMEs, and there is also

the comparison on economic performances of the five collaboration models by ANOVA.

The formula is as follows:

Profit Growth Rate per Person = $(N_1 - N_2) / N_2$

where $N_{1:}$ is the average profits per person with collaboration.

$N_{2:}$ is the average profits per person without collaboration.

Table 10

Comparison of economic performances of the five collaboration models by ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28.155	4	7.039	40.397	0.000
Within Groups	85.727	492	0.174		
Total	113.882	496			

It can be seen from Table 10 that the Column *Sig.* indicates the likelihood of an *F*-ratio, the size that obtained by chance. In Table 10, there is a probability of 0.000 that an *F*-ratio would occur by chance. Because the observed significance value is less than 0.05, we can see that there is significant effect of the economic performance. In other words, there are significant differences with respect to Profit Growth Rate per Person among the five collaboration models. From the above results, it is evident that private SMEs choose different collaboration models which will produce different effects on economic performances of enterprises. Thus, the hypothesis *H2*: "Different collaboration models will bring about different economic performances on SMEs" makes sense.

In Table 11, each group of participants is compared to all of the remaining groups. In the same way, the growth rate of the profit per person is used as the indicator of economic performance of private SMEs. For each pair of groups, the difference between group means and the standard error of that difference are displayed. And then, the group of MODEL II is compared to the remaining groups and there are significant differences. (*Sig.* are all less than 0.05), and so is the result of group of MODEL V. The other three groups only respectively have significant differences with the two groups of MODEL II and MODEL V and there are non-significant differences between the rest three groups. According to the means plots (See Figure 2), we can see that MODEL II and MODEL V have greater positive effects on the economic performance of private SMEs. Meanwhile, the effect of the other three models is not so significant in the improvement of the economic performance of private SMEs. These results are in consistent with the findings in Table 9, where the respective choices of collaboration models by private SMEs and higher education institutions have been described.

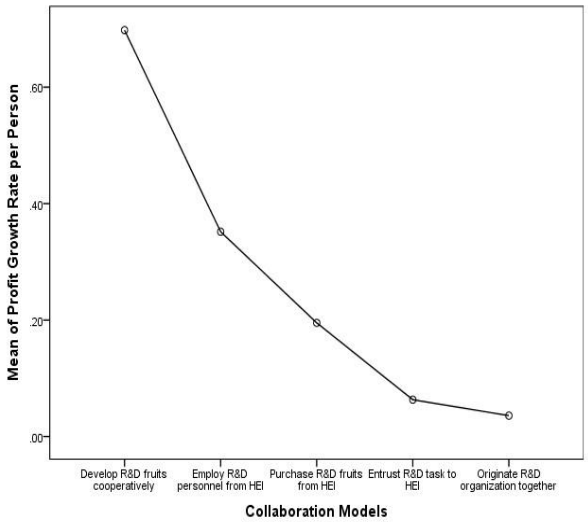


Figure 2. Means Plots

Table 11

Multiple comparisons of economic performances of the five collaboration models

(I) collaboration models	(J) collaboration models	Mean Difference (I-J)	Std. Error	Sig.
MODEL II	MODEL V	0.34623*	0.04554	0.000
	MODEL I	0.50270*	0.05138	0.000
	MODEL III	0.63470*	0.07393	0.000
	MODEL IV	0.66204*	0.10849	0.000
MODEL V	MODEL II	-0.34623*	0.04554	0.000
	MODEL I	0.15646*	0.05435	0.004
	MODEL III	0.28847*	0.07602	0.000
	MODEL IV	0.31580*	0.10993	0.004
MODEL I	MODELII	-0.50270*	0.05138	0.000
	MODEL V	-0.15646*	0.05435	0.004
	MODEL III	0.13201	0.07966	0.098
	MODEL IV	0.15934	0.11247	0.157
MODEL III	MODEL II	-0.63470*	0.07393	0.000
	MODEL V	-0.28847*	0.07602	0.000
	MODEL I	-0.13201	0.07966	0.098
	MODEL IV	0.02733	0.12440	0.826
MODEL IV	MODEL II	-0.66204*	0.10849	0.000
	MODEL V	-0.31580*	0.10993	0.004
	MODEL I	-0.15934	0.11247	0.157
	MODEL III	-0.02733	0.12440	0.826

**. The mean difference is significant at the 0.05 level.*

Analysis of Barriers to Collaboration

From the above research, we can see that the collaboration models of purchasing R&D achievements directly from higher education institutions is not favored by neither private SMEs nor higher education institutions, while other models have certain limitations too. Therefore, it is necessary to analyze the factors that affect the operation of the collaboration platform. To ensure that the platform brings a two-way success for private SMEs as well as higher education institutions, this paper is to analyze the factors of the operation from two perspectives. At first, from the perspective of private SMEs, the main factors can be categorized as follows:

(1) SMEs Barrier Factor I: Lack of efficient communication channel to the R&D achievements of higher education institutions;

(2) SMEs Barrier Factor II: Unreasonable transfer cost for the R&D achievements of higher education institutions;

(3) SMEs Barrier Factor III: Immature technology of R&D achievements of higher education institutions;

(4) SMEs Barrier Factor IV: Difficulty in the commercialization of the R&D achievements of higher education institutions;

(5) SMEs Barrier Factor V: Unclear property rights of the R&D achievements;

(6) SMEs Barrier Factor VI: No superiority over the same kind of R&D achievements in other countries;

(7) SMEs Barrier Factor VII: Uncertainty of market perspective of the R&D achievements;

(8) SMEs Barrier Factor VIII: Weak process monitoring and guarantee for the market value of R&D achievements.

Table 12

Distribution of barriers to collaborations (Private SMEs)

Barriers	Private SMEs (N = 523)	
	Number (%)	Ranking
SME Barrier Factor I	315 (60.2 %)	1
SME Barrier Factor II	267 (51.1 %)	2
SME Barrier Factor III	227 (43.4 %)	4
SME Barrier Factor IV	233 (44.6 %)	3
SME Barrier Factor V	67 (12.8 %)	7
SME Barrier Factor VI	121 (23.1 %)	6
SME Barrier Factor VII	135 (25.8 %)	5
SME Barrier Factor VIII	51 (9.8 %)	8

Remarks: Each responding enterprise can select three items at most as its major barriers.

The survey results displayed in Table 12 show that for those SMEs with collaboration experience on the collaboration platform, SME Barrier Factor I ranks first with a proportion of 60.2 % which, therefore, is identified as the most important barrier. And other factors ranking behind take up similar proportions, with SME Barrier Factor II accounting for 51.1 %, SME Barrier Factor IV 44.6 %, and SME Barrier Factor III 43.4 %. The following is the analysis of causes of the above results.

First of all, the major barrier is the lack of efficient communication channel to the R&D achievements of higher education institutions (SMEs Barrier Factor I). According to the survey, the reason why many private SMEs fail in cooperating with higher education institutions lies in the fact that enterprises do not maintain a good communication with higher education institutions and do not acquire a clear understanding of the research progress and development, which brings up uncertainty for the future and low confidence in the improvement to strength the enterprise technology through R&D achievements, eventually leading to the abortion of the cooperation. It can clearly be seen that a good communication mechanism is essential to the collaboration platform.

Secondly, unreasonable transfer cost for the R&D achievements of higher education institutions (SME Barrier Factor II) is another major barrier. The cost has always been one of the stumbling blocks that private SMEs have to face. Private SMEs have low profit margins and have various taxes and charges to pay, so they have limited funds for the technological innovation. In addition, it is difficult for these private SMEs to raise funds from society in China. Due to the limited funds, private SMEs have to budget strictly in the collaboration with higher education institutions.

Thirdly, SME Barrier Factor III&IV are also important barriers that impede the cooperation between private SMEs and higher education institutions. The reason lies in the fact that the R&D achievements developed by higher education institutions are not in accordance with the market demand. Project researchers pay little attention to the survival factors of technology, namely, its application, market competition, the cost and so on. The causes discussed above lead to the result that on one hand enterprises are eager for practical technology; on the other hand, a large number of R&D achievements of higher education institutions are unable to be utilized. In China, it is estimated that currently the transformation rate of R&D achievements in national scientific research institutions and higher education institutions is less than 20%, while R&D achievements that eventually realize industrialization account for less than 5 %.

From the perspective of universities, similarly, many factors affect their collaboration with private SMEs, which have been identified in this study as follows.

(1) HEI Barrier Factor I: Lack of efficient communication channel to SMEs;

(2) HEI Barrier Factor II: Unreasonable transfer cost for the R&D achievements of higher education institutions;

(3) HEI Barrier Factor III: Unclear property rights of the R&D achievements;

(4) HEI Barrier Factor IV: Lack of protection and guarantee for R&D achievements;

(5) HEI Barrier Factor V: Lack of effective publicity for enterprises;

(6) HEI Barrier Factor VI: Lack of understanding of enterprises;

(7) HEI Barrier Factor VII: Poor commercialization of R&D achievements.

Table 13

Distribution of barriers to collaborations (Higher education institutions)

Barriers	Higher education institutions (N = 61)	
	Number (%)	Ranking
HEI Barrier Factor I	38 (62.3 %)	1
HEI Barrier Factor II	35 (57.4 %)	2
HEI Barrier Factor III	6 (9.8 %)	5
HEI Barrier Factor IV	9 (14.8 %)	4
HEI Barrier Factor V	3(4.9 %)	6
HEI Barrier Factor VI	2(3.2 %)	7
HEI Barrier Factor VII	18(29.5 %)	3

Remarks: Each higher education institution surveyed can select three items at most as its major barriers.

We can see from Table 13 that among all the barriers, HEI Barrier Factor I ranks first with 62.3 %, which is identical to that in the survey of private SMEs. Moreover, a more striking one is HEI Barrier Factor II with 57.4 % followed by HEI Barrier Factor VII with 29.5 %, HEI Barrier Factor IV with 14.8 %, and HEI Barrier Factor III with 9.8 %. From the perspective of higher education institutions, the lack of efficient communication channel to SMEs is the most important barrier in the bilateral cooperation. Because technology development must depend on the enterprises' demand, without efficient communication in the research and development process, higher education institutions are unable to understand the needs of enterprises. Without adequate market research, R&D achievements developed thereof will be of no practical significance and not favored by enterprises despite their high technology.

What's more, most higher education institutions take the cost as a tremendous barrier to the collaboration. Meanwhile, for various reasons, higher education institutions lack confidence on the achievements that they have developed and are unable to guarantee their commercialization. Furthermore, some follow-up work for the transfer of R&D achievements to enterprises should not be ignored, such as the property ownership issue. In China, few regulations concerning about the technological transfer clearly identify the interest attribution of the technological invention. Accordingly, it is not surprising for us to see a low transformation rate.

In summary, many barriers on the S&T collaboration platform for private SMEs and higher education institutions keep the platform from a good development and disallow enterprises to obtain what they need and benefit from the collaboration. Therefore, it is necessary to explore how to improve the operation mechanism of the collaboration platform.

Preliminary Analysis of Operation Mechanism of Collaboration Platform

The collaboration platform is a carrier for R&D achievements transfer, the key of which lies in the reasonable operation. From above survey, we can see that both private SMEs and higher education institutions regard the inefficient communication channels as the biggest barrier in the collaboration. Therefore, it is obvious that good communications between enterprises and higher education institutions are decisive to the successful transfer of R&D achievements between them.

Normally, three aspects are interrelated and mutually restrained in the transformation process of R&D achievements into productivity, namely, the achievement source, intermediate part and the absorber. And the same is true for the R&D achievements transfer from higher education institutions to enterprises. The achievements researched and developed in higher education institutions are the achievement sources, the enterprises are the absorbers of the R&D achievements, while the collaboration platform is the intermediate part. The communication mechanism of the collaboration platform plays an important role of mutual connection in the R&D achievements transfer process. The communication mechanism consists of five aspects, including coordination mechanism, supervision mechanism, transmission mechanism, propaganda mechanism and guarantee mechanism. In order to get a better understanding of the performances of these five communication mechanisms in reality, and thereby find out the aspects that need to be improved in the operation of the collaboration platform, this paper takes weighting technique with Likert-type rating scale to understand the performance of the five mechanisms from both perspectives of private SMEs and higher education institutions. The method is used to rank the degree of importance for the identified mechanisms, and the rankings after weighting are also listed in the last two columns in the table. The survey results are shown in Table 14. The results indicate that more than 80 % of the private SMEs and higher education institutions (private SMEs 82.5 %; higher education institutions 86.7 %) believe that the performance of the coordination mechanism in reality is not good. Particularly 51.8 % of the surveyed enterprises and 40.4 % of the higher education institutions think this mechanism has the worst performance. From the weighting score, we can see that in the views of both enterprises and higher education institutions, there are many problems now and the top three

Table 14

Performance of five communication mechanisms

Private SMEs							
Mechanism	**1st (%)**	**2nd (%)**	**3rd (%)**	**Total (%)**	**Rank**	**Weighting score**	**Weighting rank**
Coordination	51.8	18.6	12.1	82.5	1	326.9	1
Supervision	8.9	15.1	19.6	43.6	4	109.4	4
Transmission	20.5	23.9	10.3	54.7	3	184.5	2
Propaganda	6.5	9.8	19.1	35.4	5	81	5
Guarantee	11.2	30.5	36.9	78.6	2	123.4	3
Invalid	1.1	2.1	2	5.2			
Total (%)	100	100	100				
Higher education institutions							
Mechanism	**1st (%)**	**2nd (%)**	**3rd (%)**	**Total (%)**	**Rank**	**Weighting score**	**Weighting rank**
Coordination	40.4	15.4	30.9	86.7	1	279.1	1
Supervision	3.6	9.2	18.5	31.3	5	64.1	5
Transmission	19.7	28.7	26.2	74.6	2	210.8	3
Propaganda	5.5	20.4	13.8	39.7	4	102.5	4
Guarantee	30.8	26.3	10.6	67.7	3	243.5	2
Invalid	0	0	0	0			
Total (%)	100	100	100				

mechanisms that urgently need to be improved are the coordination mechanism, the transmission mechanism and the guarantee mechanism. Learning from the results of this survey, we should take this current situation into consideration and improve the communication mechanisms of the collaboration platform from the following aspects.

Coordination mechanism

The collaboration between enterprises and higher education institutions is not only a process of R&D achievement transfer, but also a competition of interests, in which either side of the collaboration is hoping to obtain the maximum benefit. Therefore, the collaboration platform should play the role of coordination to balance the interests of both sides and help to achieve a balanced interest point at which the two sides are able to get what they need respectively and profit jointly through the collaboration. Meanwhile, both sides should get a good understanding of the collaboration content and process through the coordination so as to achieve an orderly and smooth process of the collaboration.

Transmission mechanism

The communication between enterprises and higher education institutions plays an important role in the collaboration process. The great bilateral communication will establish a bridge between the two sides and help them understand each other better, which can also achieve the maximum result. The collaboration platform should be responsible for the information transmission between the two sides in the collaboration, namely, the timely transmission of the specific information so as to ensure that both sides keep abreast of the process and circumstances of the research and the development process.

Guarantee mechanism

Enterprises and universities tend to ignore the follow-up work after the transfer of R&D achievements. Therefore, it is necessary for the collaboration platform to track the situation after the transfer, such as the application of the achievements developed by higher education institutions. For the follow-up tasks, the collaboration platform should timely coordinate both sides and assist them to solve the emerging problems. These actions are not only the interest guarantee of both sides, but also the initiatives that will promote another bilateral collaboration.

Supervision mechanism

To ensure a smooth and successful collaboration, the platform should always pay attention to the collaboration progress and supervision from both sides, which can be regarded as a guarantee for the success of the collaboration as well as a protection of the bilateral interests. Special emphasis should be put on the quality supervision and the efficiency of research and development. The supervision mechanism guarantees a successful collaboration between higher education institutions and enterprises, moreover, enables the two sides to complete the collaboration in accordance with their preconcert plan.

Propaganda mechanism

Both the enterprises and higher education institutions will be very cautious in selecting partners, for an excellent partner is a guarantee for success. Especially for universities, the reputation and prestige are intangible assets and advantage that will attract partners from different areas. Therefore, the collaboration platform should conduct detailed publicity of the strengths and dominant professionals of the higher education institutions so as to equip enterprises with ideas about research field of the universities and help them to select appropriate universities as partners according to their own specific situation.

In a word, in the process of R&D achievement transfer, the communication mechanism of the collaboration platform plays its corresponding roles and shows its importance and significance. For the collaboration between higher education institutions and enterprises, the communication mechanism of the collaboration platform is decisive to the whole process and the success of the collaboration.

Conclusions

Collaboration between industry and higher education institutions plays a significant role in the economic development and provides enterprises with strategic advantages. In this view, higher education institutions not only play a role as the creators of new technology, but also a role of the providers of much high-quality professional personnel as well as the intermediary between the economy and society. This study explores the collaborative relationship between higher education institutions and industry and researches the influence of the collaboration between higher education institutions and private SMEs in Wenzhou, China.

The main research results indicate that although the traditional collaboration forms prevail for a longtime, the collaboration platform of higher education institution, a relatively new-fashioned and perfect collaboration form, definitely has competitive advantages. Through collaboration with higher education institutions on the platform, the economic performance of private SMEs is positively related with the collaborated projects. In other words, the number of the collaboration projects is one of the factors that affect economic performance (i.e. the more collaborations, the better economic performance). Accordingly, it means that private SMEs can improve economic performance through collaborations with higher education institutions on the platform.

The results also reveal that there are five collaboration models between higher education institutions and private SMEs on the platform. The calculation results show that different collaboration models lead to different economic performances of SMEs, i.e. private SMEs that choose different collaboration models on the platform will have different effects on the economic performances of the enterprises. Meanwhile, Collaboration Model II & V have greater positive effects on the economic performance of private SMEs than the other three models. This finding is in consistent with the results of the questionnaire survey about the collaboration experience of private SMEs.

Among all the barriers to the collaboration between higher education institutions and private SMEs, "Lack of efficient communication channel" and "Unreasonable transfer cost for the R&D achievements of higher education institutions" have been identified as the most important factors. This indicates that there are serious problems in the information channels between higher education institutions and enterprises. It is necessary to develop an effective communication channel between the collaboration partners.

Successful collaborations not only depend on a strong research capacity, but also need good communications between enterprises and higher education institutions, which is decisive to the successful transfer of R&D achievements between them. In the views of both enterprises and higher education institutions, the top three mechanisms that urgently need to be improved are the coordination mechanism, the transmission mechanism and the guarantee mechanism. For the collaboration between the universities and enterprises, the communication mechanism of the collaboration platform is decisive to the whole process and success of the collaboration.

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Aukštojo mokslo institucijų ir pramonės bendradarbiavimo platforma: Wenzhou pavyzdys Kinijoje

Santrauka

Pramonės ir aukštojo mokslo institucijų bendradarbiavimas atrodo tampa vis svarbesniu daugelyje šalių. Aukštojo mokslo institucijos atlieka ne tik naujos technologijos kūrėjų vaidmenį, bet taip pat ir labai kvalifikuoto profesionalių personalo tiekėjų vaidmenį. Šiandieninėje, labai konkurencingoje aplinkoje, įmonės gebėjimas eiti kartu su technologine pažanga ir nuolatinėmis naujovėmis yra gyvybiškai svarbus jai išlikti ir tobulėti. Nepaisant to, įmonėms, ypač mažoms ir vidutinio dydžio (MVĮ), labai sunku plėtoti naujas technologijas tik pasikliaunant savo galimybėmis. Taip yra dažniausiai dėl ribotos kompetencijos ir lėšų. Kai kurie tyrinėtojai nustatė, kad aukštosios technologijos srityje, aktyvios MVĮ pasiekia didesnį našumą bendradarbiaudamos su aukštojo mokslo institucijomis. Yra plačiai pripažįstama, kad bendradarbiavimas tarp aukštojo mokslo institucijų ir pramonės turėtų būti stiprinamas ir tobulinamas, kad atitiktų didėjantį įmonių plėtros poreikį. Bendradarbiavimas tarp pramonės ir aukštojo mokslo institucijų padeda mažinti mokslinių tyrimų ir projektavimo-konstravimo darbų (plg. angl. *research and development*) kaštus, taip pat riziką. Jis skatina aukštojo mokslo institucijas ir įmones dalintis resursais ir įgyti papildomų galimybių. Bendradarbiaudamos su aukštojo mokslo institucijomis, įmonės taip pat gali sumažinti inovacijų metu atsiradusius neaiškumus, plėsti rinkas, taip pat gauti naujos patirties ir įgūdžių, palaikyti mokslo žinių siekį. Daugelyje šalių toks bendradarbiavimas tampa vis svarbesniu ekonominei plėtrai. Šiame darbe nagrinėjamas Kinijos (naujos pramoninės šalies) pavyzdys. Siekiama ištirti santykius tarp aukštojo mokslo institucijų ir pramonės, taip pat išnagrinėti bendradarbiavimo įtaką MVĮ Wenzhou mieste, Kinijoje.

Remiantis apklausa, atlikta Wenzhou rajone 523 privačiose MVĮ ir 61 aukštojo mokslo institucijose (įskaitant technines vidurines mokyklas, dvimečius koledžus, profesinio mokymo techninius institutus ir kt.) ir atliktais tyrimo rezultatais, galima teigti, kad Kinijoje egzistuoja keturios pagrindinės bendradarbiavimo formos: MVĮ tiesiogiai kontaktuoja su aukštojo mokslo institucijomis, bendradarbiavimui vadovauja vietos valdžia, socialiniai agentai susitaria dėl R&D pasiekimų ir aukštojo mokslo institucijų bendradarbiavimo. Pirmosios trys formos yra laikomos tradicinėmis. Nors jos yra seniai naudojamos, tačiau jos vis dar turi kai kurių trūkumų. Aukštojo mokslo institucijų Mokslo ir technologijos (MT) bendradarbiavimo platforma yra palyginti naujai sukurta ir puiki bendradarbiavimo forma. Platformos struktūra atspindi tikrus MT bendradarbiavimo platformos ryšius tarp privačių MVĮ ir aukštojo mokslo institucijų Wenzhou rajone. Struktūra apima ir bendradarbiavimo ryšius, ir valdžios vaidmenį. Iš vienos pusės, aukštojo mokslo institucijos perduoda įmonėms savo R&D pasiekimus ir technologijas, kuriuos daugiausia finansiškai remia ir valdo valdžia. Iš kitos pusės, MVĮ priklauso nuo aukštojo mokslo institucijų R&D pasiekimų ir technologijų, taip pat nuo savo pačių R&D. Be to, valdžia taip pat atlieka tarpininko vaidmenį visame procese. Vietinė valdžia tiekia tokias bendradarbiavimo platformą palaikančias priemones, kaip aukštojo mokslo institucijų aprūpinimas

biurais, jų darbuotojų aprūpinimas gyvenamuoju plotu Wenzhou. Aukštojo mokslo institucijos yra įtrauktos į šią bendradarbiavimo platformą. Naudodamosios platforma, privačios MVĮ gali siekti partnerystės su bet kuria aukštojo mokslo institucija, o kiekviena aukštojo mokslo institucija gali ieškoti bendradarbiavimo su bet kuria privačia MVĮ. Aukštojo mokslo institucijų biurai yra „langai“, skirti MVĮ, ir visada yra laikomi „maža bendradarbiavimo platforma“ skirta parduoti jos R&D pasiekimus. O su aukštojo mokslo institucijomis susiję skyriai, kurie apima R&D pasiekimų perdavimo biurą, pramoninių tyrimų laboratoriją, MT pasiekimų komercializacijos skyrių ir t. t., yra įtraukti į R&D pasiekimų ir technologijų perdavimą.

Akivaizdu, kad bendradarbiavimo platforma yra sudėtinga sistema, o ne paprasta linijinė struktūra, kuri suteikia daugiau pasirinkimo ir lankstumo ir privačioms MVĮ, ir aukštojo mokslo institucijoms. Abi pusės gali rinktis tinkamą temą ir bendradarbiauti laikantis tam tikrų numatytų ir susitartų sąlygų. Be to, privačios MVĮ ir aukštojo mokslo institucijos gali bendradarbiauti su daugeliu šioje platformoje dalyvaujančių objektų. Dėl šios priežasties labai padidėja jų efektyvumas. R&D pasiekimų komercializacija yra realizuojama šioje platformoje. Todėl aukštojo mokslo institucijos gauna privalumų taikant technologijas ir plėtojant mokslo pasiekimus. Šios naujos technologijos yra perkeliamos į bendradarbiavimo platformą, o vėliau, privačios MVĮ šioms technologijoms suteikia komercializacijos vertę, panaudodamos gaminiui pažangią technologiją ir tokiu būdu užbaigdamos komercializacijos procesą. Paminėtina ir tai, kad, kai šie gaminiai patenka į prekybą, susijusi su rinka informacija (pvz.: technologinis naujumas, vartotojo pasitenkinimas, gaminių ekonominiai duomenys ir t. t.) grąžinama į valdžios skyrių. Tai leidžia valdžiai kurti politiką ir pasiūlymus būsimam bendradarbiavimui. O rinkos veiklos informacija (įskaitant rinkos poreikį naujam gaminiui ir vartotojo pasitenkinimą), taip pat sugražinama į aukštojo mokslo institucijas ir įmones. Remiantis šia informacija, MVĮ ir aukštojo mokslo institucijos priima sprendimus dėl esamo perdavimo, taip pat ir dėl būsimojo bendradarbiavimo.

Naudojant nepriklausomo pavyzdžio *T-testo* ir *Pearson* koreliacijos statistinę analizę, nustatyta, kad bendradarbiaujant platformoje su aukštojo mokslo institucijomis, privačių MVĮ ekonominė veikla yra teigiamai susijusi su bendradarbiavimo projektais, kitaip tariant, bendradarbiavimo projektų skaičius yra vienas iš veiksnių, kurie daro įtaką ekonominei veiklai (t. y., kuo daugiau bendradarbiavimo, tuo geresnė ekonominė veikla). Taigi, tai reiškia, kad privačios MVĮ gali pagerinti ekonominę veiklą bendradarbiaudamos platformoje su aukštojo mokslo institucijomis.

Iš rezultatų matyti, kad platformoje, tarp aukštojo mokslo institucijų ir privačių MVĮ, egzistuoja penki bendradarbiavimo modeliai: *pirkti* R&D pasiekimus tiesiai iš aukštojo mokslo institucijų, *plėsti* R&D pasiekimus bendradarbiaujant su aukštojo mokslo institucijomis, *patikėti* R&D užduotis aukštojo mokslo institucijoms, *įkurti* R&D organizacijas su aukštojo mokslo institucijomis, *įdarbinti* technologinį personalą iš aukštojo mokslo institucijų. Remiantis ANOVA, iš skaičiavimo rezultatų matyti, kad skirtinguose bendradarbiavimo modeliuose MVĮ ekonominė veikla yra skirtinga. Tai reiškia, kad privačios MVĮ renkasi skirtingus bendradarbiavimo modelius platformoje. Todėl ekonominė veikla yra taip pat skirtinga. Lyginant modelius matyti, kad bendradarbiavimo modeliai: „plėtoti R&D pasiekimus bendradarbiaujant“ ir „įdarbinti R&D personalą iš Aukštojo mokslo institucijų“ darė didesnę teigiamą įtaką privačių MVĮ ekonominei veiklai nei kiti trys modeliai. Šis rezultatas atitinka anketinės apklausos apie privačių MVĮ bendradarbiavimo patirtį rezultatus. Iš anketinės apklausos galima daryti išvadą, kad nesvarbu ar tai būtų privačios MVĮ, ar aukštojo mokslo institucijos, dauguma jų renkasi modelį „plėtoti R&D pasiekimus bendradarbiaujant su aukštojo mokslo institucijomis“ (atitinkamai 37.9 % ir 37.7 %). Šiame bendradarbiavimo modelyje įmonių, taip pat ir aukštojo mokslo institucijų tikslai yra identiški, įskaitant ir technologinį, ir rinkos aspektą. Taip pat abi bendradarbiavimo šalys gali papildyti viena kitą lėšomis pagal būtinybę. Be to, šis modelis atskleidžia abipusio mokymosi proceso abipusę naudą.

Žvelgiant iš privačios MVĮ perspektyvos, pagrindinius veiksnius galima suskirstyti į šias kategorijas:

1) efektyvios komunikacijos kanalo su aukštojo mokslo institucijų R&D pasiekimais trūkimas;
2) nepagrįsti aukštojo mokslo institucijų R&D pasiekimų perkėlimo kaštai;
3) nepribrendusi aukštojo mokslo institucijų R&D pasiekimų technologija;
4) sunkumai komercinant aukštojo mokslo institucijų R&D pasiekimus;
5) neaiškios R&D pasiekimų nuosavybės teisės;
6) VMĮ barjero veiksnys VI: nėra jokio pranašumo prieš tokios pačios rūšies R&D pasiekimus kitose šalyse;
7) netikrumas dėl R&D pasiekimų perspektyvos rinkoje;
8) silpnas proceso kontroliavimas ir garantavimas dėl R&D pasiekimų rinkos vertės.

Iš aukštojo mokslo institucijų perspektyvos:

1) efektyvaus komunikacijos kanalo su MVĮ trūkumas;
2) nepagrįsti aukštojo mokslo institucijų R&D pasiekimų perkėlimo kaštai;
3) neaiškios R&D pasiekimų nuosavybės teisės;
4) R&D pasiekimų apsaugos ir garantijų trūkumas;
5) efektyvios reklamos įmonėms trūkumas;
6) įmonių supratimo trūkumas;
7) blogas R&D pasiekimų komercializavimas.

Iš visų bendradarbiavimo barjerų tarp aukštojo mokslo institucijų ir privačių MVĮ, „efektyvaus komunikacijos kanalo trūkumas“ ir „nepagrįsti aukštojo mokslo institucijų R&D pasiekimų perkėlimo kaštai“ buvo nustatyti kaip svarbiausi veiksniai. Tai rodo, kad informaciniuose kanaluose tarp aukštojo mokslo institucijų ir įmonių egzistuoja rimtų problemų, todėl tarp bendradarbiaujančių partnerių būtina sukurti efektyvų komunikacijos kanalą.

Platformos bendradarbiavimo mechanizmą sudaro penki aspektai, tai: *koordinavimo, priežiūros, perdavimo, propagandos* ir *garantavimo* mechanizmai. Siekiant suprasti penkių mechanizmų veiklą ir surasti aspektus, kuriuos reikia gerinti bendradarbiavimo platformos veikloje, šiame darbe panaudojama įvertinimo *Likert*-tipo vertinimo skale technika (iš privačių MVĮ ir iš aukštojo mokslo institucijų perspektyvų). Rezultatai rodo, kad daugiau nei 80 % privačių MVĮ ir aukštojo mokslo institucijų (privačios MVĮ - 82.5%; aukštojo mokslo institucijos - 86.7 %) tiki, kad koordinavimo mechanizmo veikla tikrovėje nėra gera. Imant atskirai, 51.8 % stebėtų įmonių ir 40.4 % aukštojo mokslo institucijų mano, kad šio mechanizmo veikla yra blogiausia. Pagal įvertinimo balus, galima matyti, kad ir įmonių, ir aukštojo mokslo institucijų požiūriu dabar egzistuoja daug problemų. Pirmieji trys mechanizmai, kuriuos reikia skubiai pertvarkyti yra: *koordinavimo*, *perdavimo* ir *garantavimo* mechanizmai. Įvertinus šios apklausos rezultatus, reikia konkrečiai išnagrinėti dabartinę situaciją ir priimti sprendimus kaip pagerinti bendradarbiavimo platformos komunikacijos mechanizmus.

Raktažodžiai: *Aukštojo mokslo institucijų-pramonės bendradarbiavimas, MT bendradarbiavimo platforma, privačios MVĮ, Aukštojo mokslo institucijos, komunikacijos mechanizmai.*

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