Effects of Industry-University Collaboration on Enterprises' Intellectual Capital in Zhejiang, China

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Abstract

The objectives of this study were to investigate the effects of industry-university collaboration on enterprises' intellectual capital, and studied the factors of industry-university collaboration on enterprises' intellectual capital from the perspective of cross-organizational relationship management. Survey questionnaire was used to collect the data from 406 high-tech enterprises in Zhejiang province using purposive sampling. Used exploratory factor analysis, identify and analyze the key factors that effects the enterprises' intellectual capital by industry-university collaboration. Linear multiple regression is used to analyze the variables and to test the hypothesis. The study found that the related industry-university collaboration relationship had a positive effect on enterprises' intellectual capital, while the transactional relationship had a positive effect on human capital and structure capital, but had no significant positive effect on relationship capital. Therefore, enterprises should attach importance to the establishment of related relationship with universities and further enhance enterprises' intellectual capital through effective cross-organizational management.

Keywords: Industry-university collaboration, Enterprise' Intellectual capital, Hi-Tech Industries

Introduction

There are many ways to create innovations which are very importance as sources of intellectual property for the business and industry product and service developments. One approach which often used in Europe and in the USA is the

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company-funded collaboration in the research and development centers in the education institutions (Porter, 1995). Industry-university collaboration itself is a systematic project, so it requires a close collaboration and coordination between the society and various relevant units. However, the relationships between university and enterprise plays an important role in collaboration; it is becoming an important obstacle to industry-university collaboration and a constraint on knowledge transfer (Bjerregard, 2010). Since the Chinese governments place the importance of industry-university collaboration as high level policy, they need to apply the policy into practice. The National Development and Reform Commission of the Ministry of Education, and the Chinese Academy of Sciences have jointly launched the industry-university joint development project. (Gassol,2007).

Research Questions

1. What are the effects of industry-university collaboration have on enterprises' intellectual capital ?

2. What style of relationships of industry-university collaboration that are applied in Zhejiang province ?

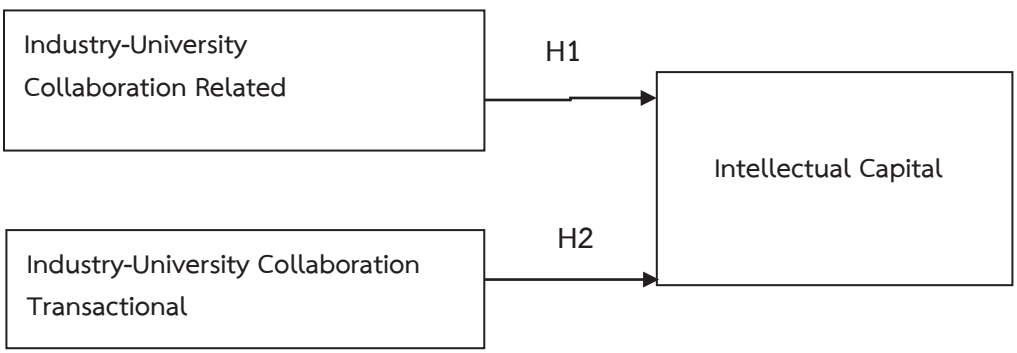
Research Objectives

1. To study the effects of industry-university collaboration on enterprises' intellectual capital.

2. To study the styles of industry-university collaboration relationship on enterprises' intellectual capital.

Research Conceptual Framework

The research conceptual framework was developed after a review of collaborative behavior between universities and industries in different countries.



Research Hypothesis

H1: Related relationship between universities and enterprises has a significant effects on enterprises' intellectual capital.

H2: Transactional relationship between universities and enterprises has a significant effects on enterprises' intellectual capital.

Research Methodology

Research Design

This research was designed as a quantitative research using survey questionnaire as the main tool to collected primary data from the sample groups. The study used One-way Analysis of Variant (One-way ANOVA), Pearson correlation coefficient and multiple regressions analysis to test the relationships of variables among industry-university collaboration and enterprises' intellectual capital, and to test the research hypothesis.

Population and Sample

The population of this study are people who are stakeholders of the industry-university collaboration includes entrepreneurs or senior managers who have a comprehensive understanding of enterprise-industry-university collaboration activities. So, the author take into account all the entrepreneurs of hi-tech industry entrepreneurs in Zhejiang province the amount of 9,047 persons. This study used Yamane (Yamane, 1973) to determine the number of samples by using purposive sampling in this study. Thus, the sample size was 383 samples.

Research Findings and Discussion

Descriptive Analysis

In order to have an intuitive understanding of all aspects of related relationship, transactional relationship and intellectual capital, a descriptive analysis was presented. The results were shown in Table 1.

Table 1 Descriptive Analysis

Item	Mean	SD	Level
Joint R&D	3.57	.82	High
Commissioned Development	3.94	.62	High
Co-construction Collaboration Agency	3.13	.77	Medium
Collaborative Training	3.38	.68	Medium
Personnel Exchange	3.03	.74	Medium
Related Relationships	3.41	.52	High
University Employee Shareholding	3.54	.78	High
Joint Construction Company	3.13	.77	Medium
Purchase Patent	3.88	.60	High
Technical License	3.35	.65	Medium
Transactional Relationships	3.47	.52	High
Human Capital	3.10	.89	Medium
Structure Capital	3.29	.83	Medium
Relationship Capital	3.85	.70	High

Table1 showed the descriptive analysis of the relationship between the related, the transactional and the various aspects of intellectual capital. The average value could be used to know the level of each variable. It could be seen that each variable was around 3.5. It showed that all aspects of the related relationship, transactional relationship and intellectual capital were at a medium level.

Table 2 Descriptive Analysis of Company Basic Information

Information	Values	Frequency	Percentage
Nature of the Company	State-Owned Enterprise	12	3.0
	State-Owned Holding Company	62	15.3
	Collectively Owned Enterprise	11	2.7
	Foreign Companies	49	12.1
	Private Enterprise	199	49.0
	Sino-Foreign Joint Venture	48	11.8
	Listed Company	25	6.2

Results from Table2 revealed that majority of the samples were private enterprise 199 enterprises accounted for 49 percent, followed by state-Owned holding company 62 companies accounted for 15.3 percent, foreign company 49 companies accounted for 12.1 percent, sino-foreign joint venture 48 companies accounted for 11.8 percent, listed company 25 companies accounted for 6.2 percent, state-owned enterprise 12 enterprises accounted for 3 percent, and collectively-owned enterprise 11 enterprises accounted for 2.7 percent.

Table 3 *Descriptive Analysis of Company Basic Information*

Information	Values	Frequency	Percentage
Industry	Electronic Information Technology	72	17.7
	Biology and New Medical Technologies	42	10.3
	New Material Technology	41	10.1
	High-Tech Service Industry	32	7.9
	New Energy and Energy Saving	53	13.1

	Technologies		
	Resources and Environmental Technology	37	9.1
	New and High Technologies Will Transform Traditional Industries	95	23.4
	Aerospace Technology	14	3.4
	Other	20	4.9

Results from Table 3 revealed that majority of the samples were New and high technologies will transform traditional industries 95 enterprises accounted for 23.4 percent, followed by Electronic information technology 72 companies accounted for 17.7 percent, New Energy and Energy Saving Technologies 53 companies accounted for 13.1 percent, Biology and New Medical Technologies 42 enterprises accounted for 10.3 percent, New Material Technology 41 companies accounted for 10.1 percent, Resources and Environmental Technology 37 enterprises accounted for 9.1 percent, High-Tech Service Industry 32 enterprises accounted for 7.9 percent, Aerospace Technology 14 enterprises accounted for 3.4 percent, and Other 20 companies accounted for 4.9 percent. After the questionnaire was identified, the companies that filled in the "other" items were all in the financial industry, the sample companies have a wide industry distribution and sample data is highly representative.

Table 4 *Descriptive Analysis of Company Basic Information*

Information	Values	Frequency	Percentage
Established Time	Less than 5 Years	63	15.5
	6-10 Years	48	11.8
	11-20 Years	190	46.8
	More Than 20 Years	105	25.9

Results from Table 4 revealed that majority were the samples which had 190 enterprises with 11-20 years account for 46.8%, 105 enterprises with more than 20 years account for 25.9%, 63 enterprises with less than 5 years account for 15.5%, and 48 enterprises with 6-10 years account for 11.8%. The National High-tech Enterprise Certification Management Regulations stipulate that enterprises with high-tech enterprise qualifications must operate for more than three years. Because the research object is a high-tech enterprise with experience in industry-university collaboration, the longer the company has been established, the higher the possibility of collaboration with the university and the more collaboration experience.

Table 5 *Descriptive Analysis of Company Basic Information*

Information	Values	Frequency	Percentage
Annual Sales Revenue of the Company (RMB)	21-50Million	62	15.3
	51-100Million	112	27.6
	101-500Million	55	13.5
	501-1000Million	36	8.9
	1001-5000Million	42	10.3
	More Than 5000Million	99	24.4

Results from Table 5 illustrated that majority of the annual sales revenue of the company samples were 51-100 million Yuan 112 enterprises accounted for 27.6 percent, followed by more than 5000 million Yuan 99 companies accounted for 24.4 percent, 21-50 million Yuan 62 companies accounted for 15.3 percent, 101-500 million Yuan 55 companies accounted for 13.5 percent, 1001-5000 million Yuan 42 companies accounted for 10.3 percent, and 501-1000 million Yuan 36 enterprises accounted for 8.9 percent.

Table 6 *Descriptive Analysis of Company Basic Information*

Information	Values	Frequency	Percentage
Inauguration Years	4 Years or Less	25	6.2
	5-6 Years	43	10.6
	7-10 Years	64	15.8
	More Than 10 Years	274	67.5

Results from Table 6 revealed that majority were the samples whom had more than 10 inauguration years were 274 occupied 67.5 percent, followed by 7-10 inauguration years were 64 occupied 15.8 percent, 5-6 inauguration years were 43 occupied 10.6 percent, and 4 inauguration years or less 25 occupied 6.2 percent.

Overall, the quality of the sample data was better, further improving the credibility and persuasiveness of the stupid.

-Nature of the Company

In order to study whether there are significant differences in the aspects of the company's administrative differences, One-way ANOVA analysis of variance was performed. It could be concluded that, when the significance level was 0.05, the Sig value of One-way ANOVA of people from different companies in joint R&D was 0.000, which means less than 0.05, so it was considered that people from different companies in joint R&D have significant differences.

-Industry

In order to study whether there are significant differences in various aspects among people in different industries, One-way ANOVA was carried out. It could be concluded that, when the significance level was 0.05, the Sig value of One-way ANOVA of people in different industries in joint R&D was 0.121, greater than 0.05.

-Establishment Years

In order to study whether people with different years of establishment have significant differences in various aspects, One-way ANOVA was carried out. It could be concluded that the Sig value of the One-way ANOVA in joint research

and development has a Sig value of 0.000 and less than 0.05 at a significance level of 0.05.

-Annual Sales Revenue of the Company

In order to study whether there are significant differences in the company's annual sales income in various aspects, One-way ANOVA analysis of variance was performed. It could be concluded that at a significance level of 0.05, the Sig value of the One-way ANOVA of joint research and development of the company with different annual sales income was 0.087, greater than 0.05.

-Inauguration Years

In order to study whether there are significant differences in various aspects of people with different years of employment, One-way analysis of variance was performed. It could be concluded that at a significance level of 0.05, The Sig value of the One-way ANOVA of joint R&D for people with different R&D investment in sales revenue was 0.451, which was greater than 0.05.

Research Findings

The results from descriptive analysis found that most of the high-tech enterprises in Zhejiang province are private enterprises with a wide industry distributed. The longer the enterprise was established, the more likely it was to collaborate with universities, the more collaborative experiences it has, the stronger the collaborative relationship, and the greater the impact on the enterprises' intellectual capital.

The results found related industry-university collaboration relationship has a positive impact on the company's intellectual capital (assuming H_1 was established), and the company attaches importance to the management of related relationship such as joint R&D, commissioned development, personnel exchange, collaborative training, and co-construction collaboration agency. It has a positive impact on the improvement of enterprises' intellectual capital.

The results from this study found the positive impact of the related industry-university collaboration relationship on the structure capital and human capital of the enterprises' intellectual capital is significantly higher than that of the transactional collaboration relationship, and the related relationship has a strong positive impact on enterprises' relationship capital, however, transactional relationship have little positive impact on enterprises' relationship capital.

Table 7 *Hypothesis Verification Results of the Effects of Industry-University Collaboration on Enterprises' Intellectual Capital*

	Hypothesis	Results
H_1	Relationship between universities and enterprises have a significant influence on the enterprises' intellectual capital	Accepted
H_2	Transactional relationship between universities and enterprises have a significant influence on the enterprises' intellectual capital	Partially Accepted

Conclusions and Recommendations

Conclusions

The results from the empirical analysis of the impact of industry-university collaboration on enterprises' intellectual capital, industry-university collaboration can effectively promote the improvement of enterprises' intellectual capital. The results found that construction of the related relationship based industry-university collaboration relationship can effectively promote the accumulation of intellectual capital.

Recommendations for Future Research

1. Due to the actual situation in China, the data obtained by this research are mainly concentrated in the engineering disciplines with relatively close collaboration between industry and university.

2. The effects of industry-university collaboration on enterprises' intellectual capital may be related to the nature of the enterprise, the type of university and the way of collaboration.

3. It is hoped that the latter researchers can expand the sample size on the one hand and expand the research area on the other hand, making the research sample more applicable.

References

Arvanitis, Josep Maria and Arauzo Carod.(2018). Sources of innovation and industry-university interaction: Evidence from Spanish firms. **Research Policy**. (8):1283-1290.

Chao Liu, Yosha.(2018). **Stage financing and the role of convertible securities. London Business School**. IFA Working Paper No. 253-1997.

Chen Jin, Yufen Chen. (2018). Research on enterprise technology innovation performance evaluation index system [J]. **Science of science and technology management**. 27(3): 86-91.

Gassol. (2007). **University Industry Relations: A Review of Major Issues**. Cooperative research and development: Springer Netherlands.43-62.

Gongxia Qin. (2017). Based on the employee trust enterprise knowledge sharing research. **Journal of management science, and science and technology**. (I0): 103-105.

Guilong Zhu, Kuiyan Li. (2018). Analysis of factors influencing the performance of industry-university collaboration [J].**Science and Technology Management Research**, 4:90-91.

Janet E L, ect. (2017). Fishing upstream: Finn innovation strategy and university research alliances. **Research Policy**. (7): 930-948

Porter.(1995). Neither market nor hierarchy: network forms of organization. **Research in Organizational Behavior**. (12): 295-336.

Ruoyu Lu, Zhang Peng, Hongqi Zhang.(2017). Research on industry-university collaboration model. **Science Research**. (2):186-193R.

Shijun Chen, Zhiming Cui.(2017). The characteristics of the tacit knowledge transfer and pattern analysis. **Journal of dialectics of nature**. 2: 62-68.

Tianying Jiang, Junjiang Wang.(2018). Studying organizational culture through rites and ceremonials. **Academy of Management Review**. (9):653-669.

Tijssen R J W.(2006). Universities and industrially relevant science: Towards measurement models and indicators often trap reburial orientation. **Research policy**. 35(10):1569-1585.

Wei Yao.(2018). Enterprise knowledge assets the behavior of the structure and the pattern choice. **PhD thesis, xi 'an jiaotong university**.432-433.

Yuming Wu, Lei Li.(2018). **Knowledge transfer characteristic research**. System engineering theory and practice.10:8-11.

Yanhong Yao, et al.(2018). Technology transfer and the research university: a search for the boundaries of university-industry collaboration. **Research Policy**. 25(6): 843-863.