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Research on the Influencing Factors of Industry-University-Research Integration Innovation in Xi'an

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ABSTRACT
The innovation of industry-university-research integration plays an important role in effectively promoting the integration and distribution of resources, enhancing the technological capabilities and competitiveness of enterprises, promoting the development of the regional economy, and promoting industrial upgrading. In response to the needs of market development, Xi'an has also made various attempts in the innovation of industry-university-research integration. However, the practice in recent years has shown that the efficiency of industry-university-research integration innovation in Xi'an is relatively low. In order to explore the reasons, this paper identifies Xi'an based on theoretical analysis. The influencing factors of the city's industry-university-research integration innovation are then designed through the identified influencing factors, and finally the influencing factors that affect Xi'an industry-university-research integration innovation are found based on the results of the questionnaire. The research results show that the same influencing factors have different degrees of influence on enterprises, universities and scientific research institutions; the innovation ability of the cooperative entities, the cooperation model of industry-university-research institutes, the level of achievement transformation, the smoothness of information sharing and the level of cooperation among the cooperative entities influence the integration and innovation of Xi'an industry-university-research key factors.

Keywords: *Industry-University-Research Cooperation, Integrated innovation, Influencing factors, Questionnaire survey method*

1. PREFACE

Since the 1980s, my country's industry-university-research cooperation has begun to develop slowly, and after years of practice, substantial progress has been made, such as diversification of industry-university-research cooperation models, expansion of cooperation entities, industry-university-research cooperation centers, and The industry alliance is established. Industry-university-research integration innovation is based on the cooperation of industry-university-research institutes to further optimize and upgrade cooperation entities and innovation elements. It embodies the characteristics of dynamics, diversification, and continuity. As an important city for economic development in the western region, Xi'an has also made some progress in the innovation of industry-university-research integration, but compared with other regions, its economic development level is relatively low, indicating that the efficiency of industry-university-research integration innovation is low. Therefore, starting from the current situation of Xi'an's industry-university-research integration innovation, it is of great significance to study the influencing factors of Xi'an industry-university-research integration innovation.

Judging from the research status at home and abroad, the influencing factors of the innovation of industry-university-research integration are mainly studied from the internal and external aspects. From the perspective of internal factors, existing studies mainly focus on the transaction costs of industry-university-research institutes (David, 2007)[1], the ability and resources of industry-university-research innovation entities (Santoro and Gopalakrishnan, 2001) [2], technological innovation opportunities and innovative products Demand (James, 2005) [3], Organizational Learning Theory (Simon, 2012)[4], Cost and Risk Sharing (Eom, 2010)[5], Purpose of Industry-University-Research Cooperation (Jun Qin, 2011) [6] , Collaborative willingness among innovation subjects, heterogeneity of knowledge, and knowledge capabilities of innovation subjects studied the influencing

factors of industry-university-research collaborative innovation (Lin Luo et al., 2017) [7] . From the perspective of external influence factors, existing studies mainly focus on social relations and mutual exchanges (Howard, 2016) [8], industrial alliances, resource alliances, and investor evaluation (Heil et al., 2017) [9], regional development perspectives, Government intervention (Tongtong Jiang, Xiuguo Wu, 2017; Lin Li, 2020)[10][11], platform support, synergy mechanism, synergy and cooperative relationship (Huifang Zhao et al., 2018)[12], economic factors, technology market scale , Product market demand, input and output of industry-university-research collaborative innovation (Weihong Wu et al., 2018) [13], talents, financial support, technology funding (Xiancong Wu, 2019) [14], intermediary service agencies and other aspects have studied the influencing factors of industry-university-research collaborative innovation(Guohong Wang, Liming Liu, Rui Xing, 2017) [15] .

In summary, the current research results of domestic and foreign scholars on the influencing factors of industry-university-research collaborative innovation have been abundant. However, from the perspective of the research area, most of our scholars are concentrated in the economically developed areas in the east, and they pay less attention to the development of collaborative innovation of industry, university and research in the west. Therefore, this paper analyzes the influencing factors of Xi'an's industry-university-research integration innovation through a questionnaire survey, and puts forward relevant policy recommendations based on core factors.

2. BASED ON THEORETICAL ANALYSIS OF THE FACTORS AFFECTING INNOVATION OF INDUSTRY-UNIVERSITY-RESEARCH INTEGRATION

2.1 Internal factors of the partner

(1) Corporate perspective. Enterprises are the main participating members of industry-university-research integration innovation, and their internal environmental factors have a great impact on the willingness of enterprises to participate in industry-university-research innovation and the final performance of industry-university-research innovation. Existing research points out that these internal factors mainly include enterprise scale and enterprise research and development. Team, corporate R&D investment, etc. The impact of enterprise scale on the innovation of industry-university-research integration is mainly manifested in the aspects of taking risks, responding to emergencies, and obtaining information. The larger the scale of an enterprise, the stronger the capabilities in these aspects, which will have a positive impact on the innovation of industry-university-research integration. ; The stronger the R&D team capacity of an enterprise, the stronger its knowledge absorption capacity, indicating that it can well absorb and utilize external innovation resources, and improve the level of collaboration among the main body of industry-university-research cooperation; enterprises increase their R&D investment, indicating the integration of industry-university-research innovation Sufficient funds in the process not only avoided financial problems, but also improved the transformation level of innovation results in the integration of industry, university and research.

(2) The perspective of academic research institutions. As the main body participating in the innovation of industry-university-research integration, academic research institutions mainly include scientific researchers directly involved in innovation and internal environmental factors of the academic research institutions. First of all, in terms of scientific researchers, the main influence on the innovation of industry-university-research integration is their own capabilities and values. If researchers have strong innovation ability, communication skills, coordination skills and a wealth of professional knowledge reserves, they will have a great willingness to participate in industry-university-research integration innovation; at the same time, if researchers maintain a positive and optimistic attitude towards industry-university-research integration innovation, The willingness to serve the society is very strong, and these will encourage researchers to devote themselves to the innovation process of integration of industry, university and research. The second is the internal environmental factors of academic research institutions, which are mainly related to the three aspects of incentive mechanism, innovation atmosphere and R&D conditions. The incentive mechanism mainly refers to the fact that universities and research institutions give some material or spiritual rewards to personnel participating in industry-university-research cooperation, so as to increase the willingness of teachers or R&D personnel to participate in industry-university-research cooperation. The innovation atmosphere means that if universities and scientific research institutions attach great importance to innovation and have achieved relatively good achievements in innovation, the innovation atmosphere will be relatively strong, and the willingness to participate in the integration of industry, university and research will increase. R&D conditions refer to the objective conditions for universities and scientific research institutions to innovate, such as whether innovation laboratory equipment is complete, whether innovation resources are abundant, whether there are cooperation platforms and intermediary service agencies, etc. These objective conditions are the integration of production, education and research between universities and scientific research institutions If the most basic conditions for innovation are not met, the possibility of participating in industry-university-research cooperation will be very low.

2.2 External factors of the partner

The external influencing factors of the cooperative entities mainly include the intermediary service system, the market and economic environment, the role of the government and the policy environment, and financial institutions. In the process of industry-university-research integration innovation, the government, as a guide, can formulate relevant policies to promote the development of industry-university-research integration innovation; the market and economic environment are important external factors influencing industry-university-research integration innovation, because innovation results must meet market development needs. So as to promote the development of regional economy. The intermediary service system and financial institutions provide technical, management and financial support for the integration and innovation of industry, university and research. Intermediary service agencies are the bridges and links for the integration and innovation of industry, university and research institutions. In the initial stage of cooperation, they can bridge the cooperation between enterprises and academic institutions, and can provide professional technical support during the cooperation process. Financial institutions can broaden financing channels for the integration and innovation of industry, education and research. Sufficient funds to improve the level of achievement transformation. Therefore, the external factors of the cooperation relationship are the guarantee factors for Xi'an's industry-university-research cooperation. Improving the intermediary service system, investment and financing system and policy environment will all make the integration and innovation of Xi'an industry-university-research more stable development.

2.3 Relational factors among cooperative entities

The relationship between the cooperative subjects refers to the willingness to cooperate, the degree of trust and the smoothness of information sharing of the three parties in the process of cooperation between industry, university and research. The first is the increased willingness to cooperate, and the relationship between industry, university and research integration innovation will be more stable. Participants will actively share their own superior resources and strengthen communication with each other, thereby enhancing overall collaborative innovation capabilities and accelerating the integration of innovative products and market economy. Effective integration. The second is the degree of trust between each other. When enterprises, universities and research institutes participate in fusion innovation, they must trust each other, so that the overall cooperative relationship will be closer and more stable, and the advantages of each other's resources can be integrated; at the same time, the cooperation entities must mutually trust each other. Trust can not only avoid unnecessary conflicts, but also maximize the role of the team to achieve a win-win cooperation. Finally, there is the smoothness of information sharing between each other. The main purpose of industry-university-research integration innovation is to effectively transfer the knowledge, technology and other innovative elements of universities and scientific research institutions to enterprises, and improve their technological innovation capabilities and product competitiveness[16]. The key factor for the success of the transfer is the smoothness of information sharing. Only when the channels for information sharing are smooth can the integration of the elements of industry, university and research innovation be achieved.

2.4 Objective factors for the integration of production, education and research

The objective factors of industry-university-research integration innovation refer to the modes, profit distribution methods and risk sharing methods adopted in the process of cooperation. The first is the industry-university-research cooperation model. There are many types of industry-university-research cooperation models. Different cooperation models have different cooperation scales, innovative resources and innovation efficiency, and will have different impacts on the overall industry-university-research integration innovation. Therefore, appropriate industry-university-research cooperation is adopted. The model will increase the success rate of industry-university-research integration innovation. Then there is the interest distribution method. The purpose of the cooperation between the industry, university and research institutes is to achieve resource sharing and use each other's superior resources to meet their own interests. Therefore, the interest distribution method can directly affect whether the three parties of industry, university and research can successfully cooperate and formulate a reasonable The profit distribution method can make the three parties of industry, university and research more motivated to carry out integrated innovation, so as to achieve the highest efficiency of integrated innovation of industry, university and research. Risk sharing is also another manifestation of the benefit distribution method. Only when a reasonable risk sharing method is formulated can the benefit distribution method be fairer and more reasonable, and the participants can achieve benefit sharing and risk sharing.

2.5 Innovative effect factors of industry-university-research integration

The factors of the innovation effect of the integration of industry, university and research mainly include the level of collaboration of the main partners and the level of achievement transformation. The level of cooperation of the cooperative entities refers to whether the cooperation relationship between the participating entities is close and

the degree of cooperation is tacit in the whole process of the integration and innovation of industry, university and research. A higher level of collaboration is not only conducive to each participant's own advantages, but also conducive to the overall management of the industry-university-research cooperation process, so as to maximize the innovation efficiency of industry-university-research integration innovation, and each participant can also maximize the benefits. Then there is the level of achievement transformation. The level of achievement transformation is the last step of industry-university-research integration innovation. The level of transformation directly determines the success of industry-university-research integration innovation. This factor intuitively reflects the innovation effect of industry-university-research integration innovation. Based on the analysis of the above-mentioned related theories, the influencing factors that may affect the innovation of industry-university-research integration are sorted out. The specific results are shown in Table 1.

Table 1. List of influencing factors of industry-university-research integration innovation

Serial number	Influencing factors
1	Cooperating body strength
2	Innovative ability of the partner
3	Incentive System
4	Market and economic environment
5	Government role and policy environment
6	Intermediary Service System
7	Financial institution
8	Willingness to cooperate
9	Accessibility of information sharing
10	Trust
11	Industry-University-Research Cooperation Model
12	Benefit distribution method
13	Risk sharing method
14	Cooperation level of the main body of cooperation
15	Achievement transformation level

3. BASED ON THE QUESTIONNAIRE SURVEY METHOD TO ANALYZE THE INFLUENCING FACTORS OF XI'AN INDUSTRY-UNIVERSITY-RESEARCH INTEGRATION INNOVATION

3.1 Questionnaire design

Due to the unbalanced regional economic development in my country, the impact on the innovation of industry-university-research integration is also different. There is a lot of industry-university-research cooperation in economically developed areas and the innovation efficiency is relatively high. It can adapt well to the regional economy and effectively promote local economic development. However, the effect of industry-university-research cooperation in areas with slightly underdeveloped economies is not obvious, and there are many problems. Good service of innovation results to economic development. Therefore, this article uses a questionnaire survey method to analyze the status quo and existing problems of Xi'an industry-university-research collaborative innovation, and then analyzes the influencing factors that hinder the in-depth development of Xi'an industry-university-research collaborative innovation based on the survey results, and the influencing factors obtained by this method are more important. Targeted and more representative.

This paper designs the questionnaire based on the influencing factors analyzed in the previous theories[17], which mainly include the following four aspects: basic information of the main body of cooperation, government policies, innovation of industry-university-research integration, and achievement transformation. This questionnaire survey was carried out in enterprises, universities and research institutes participating in industry-university-research cooperation in Xi'an. The subjects of the survey were corporate executives and related technical R&D personnel, teachers engaged in scientific research work in universities, and technical personnel of scientific research institutes. 159 were distributed and recovered. There are enterprise questionnaires and 102 academic questionnaires.

3.2 Survey results and analysis

According to the returned questionnaire, the influencing factors affecting the innovation of industry-university-research integration of enterprises, universities and scientific research institutions are summarized, and the influencing factors of industry-university-research integration innovation in Xi'an are analyzed according to the mean and difference of the proportions of the three influencing factors[18]. The specific survey results are shown in Table 2 and Table 3.

Table 2. Investigation on the innovation of industry-university-research integration in Xi'an

Influencing factors	Enterprise (as a percentage of the total number of people in the survey)	Universities and research institutions (percentage of the total number of people surveyed)	Mean	Difference (Universities and Research Institutions-Enterprises)
Achievement transformation level	56.77%	58.82%	57.80%	2.05%
Cooperation level of the main body of cooperation	43.40%	50.00%	46.70%	6.60%
Innovative ability of the partner	67.92%	79.41%	73.67%	11.49%
Incentives	34.15%	58.82%	46.49%	24.67%
The basis of mutual trust	37.74%	41.18%	39.46%	3.44%
Accessibility of information sharing	47.17%	61.76%	54.47%	14.59%
Benefit distribution method	37.74%	32.25%	35.00%	-5.49%
Risk sharing	39.62%	41.18%	40.40%	-1.56%
Industry-University-Research Cooperation Model	73.17%	67.65%	70.41%	-5.52%
Government support	47.17%	35.29%	41.23%	-11.88%
Financial institution support	39.62%	2.92%	21.27%	-36.70%
Intermediary Service Agency	41.51%	26.47%	33.99%	-15.04%

Table3. Survey on the transformation of innovation achievements in universities in Xi'an

Problems in the transformation of technological achievements	Percentage of the total number of people in the survey
Incentive mechanism for achievement transformation is not perfect	67.65%
Channels for result conversion are not smooth	52.94%
Scientific and technological achievements do not meet market demand	44.12%
Awareness of achievement transformation is not strong	52.94%
Lack of talents who can transform results	44.12%
Insufficient funds for achievement transformation	50.00%

(1) Comparative analysis of main influencing factors

It can be seen from the fifth column of Table 2 that the same influencing factors have different degrees of influence on enterprises, universities, and scientific research institutions, including the collaboration level of the partner, the innovation ability of the partner, the incentive policy, the basis of mutual trust, and the smoothness of information sharing. This influencing factor has a relatively large impact on universities and scientific research institutions, while the six influencing factors, namely, interest distribution methods, risk-taking methods, industry-university-research cooperation models, government support, financial institution support, and intermediary service organizations, have a relatively large impact on enterprises.

Compared with enterprises, universities and scientific research institutions have a difference of 24.67% and 14.59% in the proportions of incentive policies and accessibility of information sharing, respectively, indicating that the staff of universities and scientific research institutions are more affected by incentive policies and accessibility of information sharing. This may be because the current innovation achievements of colleges and scientific research institutions in Xi'an are mostly linked to academic research, and the innovation of industry-university-research integration pays more attention to market value. Therefore, it is hoped that relevant incentive policies will be formulated in the integration of industry-university-research innovation. The idea of "On" gives teachers or researchers some motivation to participate in the innovation of industry-university-research integration. At the same time, because universities and scientific research institutions pay more attention to academic research, they are not sensitive to market trends, and there is a phenomenon of information asymmetry. Enterprises need to share relevant information in an all-round way, so that innovation results can be more likely to be connected with the market.

Compared with universities and scientific research institutions, the proportions of the three influencing factors of government support, financial institution support and intermediary service institutions are 11.88%, 36.70%, and 15.04%, respectively. These three influencing factors are all external support factors. In the process of industry-university-research integration and innovation, enterprises need more external capital and technical support. This may be because most universities and scientific research institutions can apply for scientific research funding, and there are little restrictions on funds and policies in the process of industry-university-research integration innovation, and enterprises, as market players, also provide part of the funds in the process of industry-university-research integration innovation. For the company's own development, the government needs to formulate relevant policies and provide certain financial support. At the same time, in the large-scale industry-university-research cooperation model, it is necessary to establish cooperative entities or industrial parks, which require a large investment of funds, and most companies are unable to provide all operating funds at one time. At this time, it is necessary to broaden the investment and financing system and introduce external Financial institutions join industry-university-research cooperation.

(2) Overall longitudinal analysis of influencing factors

According to Table 2, among the influencing factors of industry-university-research collaboration innovation among enterprises and universities in Xi'an, the innovation capacity of cooperative entities accounted for 67.92% and 79.41% of the total surveyed persons, respectively, indicating that this influencing factor has the deepest impact on Xi'an industry-university-research cooperation. The most important influencing factor for the integration of study and research. At the same time, theoretically speaking, the innovation ability of each participant of industry-university-research institute is the core of industry-university-research cooperation. If the innovation ability of the cooperative entities is not strong, the possibility of cooperation will be very low. Therefore, in the process of industry-university-research cooperation, it is necessary to attach great importance to the innovation capabilities of both parties, and the government can also enhance the innovation capabilities of the main players involved in industry-university-research in terms of funds, talents and technology.

The second degree of influence on Xi'an industry-university-research integration innovation is the industry-university-research cooperation model. 67.65% of colleges and universities believe that the main problem in Xi'an industry – university - research collaborative innovation is that the cooperation model is not innovative enough. Affect the effect of collaborative innovation of industry, university and research Through further investigation, we learned that Xi'an currently has a technology transfer model, a technology joint development model, a cooperative co-construction entity, a joint laboratory or a science and technology park, a joint training of talents, and the establishment of an industrial technology alliance. 64.71% of teachers in colleges and universities participate in the technology transfer and technology joint development model, the rest are about 30% respectively, and about 53% of the enterprises participate in the technology joint development model and cooperative joint construction entity. It can be seen that Xi'an industry There are many modes of cooperation between universities and research institutes, but technology transfer and joint technology development are the main modes of cooperation. These two modes have a small scale, short time, and low impact on innovation. Therefore, Xi'an needs to develop a new and long-term

cooperation model based on the characteristics of its own industry, university and research development.

The third degree of influence on the in-depth integration of industry, university and research in Xi'an is the level of achievement transformation. 56.77% of enterprises, 58.82% of universities and scientific research institutions respectively believe that the level of achievement transformation has affected the collaborative innovation of industry, education and research in Xi'an. There are many reasons for the low level of achievement conversion. It can be seen from Table 3 that 67.65% of teachers pay more attention to the academic achievement incentive mechanism, but colleges and universities ignore the achievement transformation incentive mechanism, which makes teachers' awareness of achievement transformation weak; and 52.94% of teachers report that there are few channels for technological achievement transformation, even if There is a strong ability to innovate, but there is no platform for market operation, which greatly wastes scientific and technological resources. Therefore, the Xi'an government needs to urge Xi'an colleges and universities to improve the incentive mechanism for the transformation of production, education and research results, and to improve the awareness of the transformation of results of teachers and researchers, so that scientific and technological achievements can meet market needs. At the same time, it will provide financial support for achievement transformation, increase achievement transformation channels, and cultivate professional talents for achievement transformation, so as to improve the transformation level of Xi'an's industry-university-research achievements.

The fourth degree of influence on Xi'an's industry-university-research integration innovation is the smoothness of information sharing. 61.76% of universities and 47.17% of enterprises believe that in the process of industry-university-research cooperation, there is information asymmetry between each other, especially most Of colleges and universities believe that information sharing with enterprises is not comprehensive, leading to problems such as inconsistent technological achievements with market demand and low level of achievement transformation in later stages. Therefore, we need to pay attention to the degree of information sharing among the participating entities of industry, academia and research, increase information sharing platforms and methods, so that all participating entities are more closely connected and the level of collaborative innovation is higher.

The fifth degree of influence on Xi'an's industry-university-research integration innovation is the level of cooperation of cooperative entities. 50% of universities and 43.4% of enterprises believe that the level of collaboration of cooperative entities has affected Xi'an's industry-university-research integration innovation. The level of cooperation of the main body of cooperation reflects the ability of cooperation and assistance in the process of cooperation of the participants in the integration of production, education and research. If you want to better manage the development of industry-university-research integration innovation, the partners need to have a higher level of collaboration, so that not only can the problems that arise in the process of industry-university-research integration innovation be handled in a timely manner, but it is also conducive to the sharing of benefits for all participating entities. Therefore, on the basis of the above-mentioned influencing factors, it is necessary to promote the in-depth development of Xi'an industry-university-research collaborative innovation from the overall level of collaboration.

4. CONCLUSIONS AND POLICY RECOMMENDATIONS

4.1 Research conclusion

(1) The same influencing factors have different degrees of influence on enterprises, universities and scientific research institutions. Compared with enterprises, universities and scientific research institutions are more affected by internal factors. The incentive policies formulated within universities will affect teachers' willingness to participate in production, teaching and research. The reasons for information asymmetry make universities and scientific research institutions more affected by the unobstructed information sharing. Big. Compared with universities and scientific research institutions, enterprises are more affected by external factors and need more support from the government, financial institutions and intermediary service agencies in terms of policies, funds and technology.

(2) Through further analysis of the questionnaire survey, the key factors affecting Xi'an industry-university-research integration innovation are found. The innovation capability of the cooperative entities has the deepest impact on Xi'an industry-university-research cooperation. The fourth is the accessibility of information sharing, and the fifth is the level of cooperation among the partners. That is to say, when conducting industry-university-research integration innovation, not only should we pay attention to the objective conditions such as the innovation ability, mutual trust and cooperation level of each participant of industry-university-research research, but also choose the appropriate industry-university-research cooperation model to promote good industry-university-research integration innovation. development of.

4.2 Policy recommendations

(1) Starting from the main body of industry-university-research cooperation, that is, to improve the innovation ability of the cooperative main body and improve the relationship between the main body of the industry-university research cooperation. The main bodies of industry-university-research cooperation should strive to improve their own innovation capabilities, enrich their own innovation resources, enhance mutual trust and communication efficiency, and ensure that their advantageous resources can be shared with each other, so as to maintain a good cooperative relationship between industry-university-research institutions. At the same time, considering the innovative operation model of industry-university-research integration, when conducting industry-university-research cooperation, we must choose an appropriate innovation model of industry-university-research integration based on the strength of the partners and innovation resources, which can not only meet its own needs, but also promote the economic development of Xi'an.

(2) In the process of industry-university-research integration and innovation, strengthen the attention to the external market environment, intermediary service agencies, investment and financing environment, and policy environment. First, we must promote the development of Xi'an's real economy and provide a good development space for industry-university-research integration innovation; secondly, Xi'an municipal government must formulate special industry-university-research integration innovation policies to strengthen the government's supervision and guidance role; further establish and improve the intermediary service system, Clarify the responsibilities of intermediary service agencies and establish a reward and punishment mechanism to effectively provide assistance for industry-university-research integration innovation; improve the investment and financing environment for industry-university-research integration innovation in Xi'an, and encourage financial institutions to join the cooperation process to contribute to the development and innovation results of industry-university-research integration innovation Provide financial support for conversion.

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