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Research on the Influence of Deep Integration of Industry-University-Research on Enterprise Intellectual Capital—A Case Study of the Yangtze River Economic Belt

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Abstract

The research found that the deep integration of industry-university-research has a great promotion effect on the improvement of enterprise intellectual capital. First of all, the deep integration of industry-university-research can accelerate the innovation of enterprises in the field of scientific research technology, help the transformation of achievements of the country and enterprises in major scientific research projects, thus improving the economic benefits of enterprises and serving social development; Secondly, the deep integration of industry-university-research is also conducive to improving the competitive strength of enterprises and absorbing more think tanks and innovative technologies for enterprises; Thirdly, the deep integration of industry-university-research also conforms to the common development goals and tasks of universities and enterprises under the background of university-enterprise cooperation, and helps to build a high-quality talent training system, and ultimately feeds back the human resources development of enterprises. Taking the Yangtze River Economic Belt as an example, this paper analyzes the impact of deep integration of industry-university-research on enterprise intellectual capital, and puts forward countermeasures to improve enterprise intellectual capital through deep integration of industry-university-research.

Keywords

Deep Integration of Industry-University-Research, Enterprise Intellectual Capital, Yangtze River Economic Belt

1. Introduction

The Yangtze River Economic Belt is an important area of China's economic development (Lin & Yang, 2021). It concerns whether the overall development of China's economy and the overall planning strategy can be truly implemented, so as to smooth the double circular economic artery in the domestic region and the international scope (Wang, 2022). On December 28, 2021, as the Conference on the Integrated Development of Industry and Education of the Yangtze River Education Innovation Belt was held in Nanjing, many enterprises, universities and scientific research institutions in the Yangtze River Economic Belt discussed how to promote the innovation of talent training mechanism under the university-enterprise cooperation mode through the deep integration of industry-university-research, promote the transformation of scientific research and education achievements in the Yangtze River Economic Belt, and drive the economic development along the Yangtze River. It provides a guideline for the future development direction of the deep integration of industry-university-research in the Yangtze River Economic Belt.

In recent years, the deep integration of industry-university-research in the Yangtze River Economic Belt has been developing rapidly. A group of universities represented by Nanjing University of Aeronautics and Astronautics, Nanjing University, Huazhong University of Science and Technology, Fudan University, Tongji University, focusing on the national key development of scientific research fields, committed to breaking through the international community of key technologies, cooperation with many enterprises, scientific research institutions, to build a series of high-quality, high-level scientific innovation cooperation bodies, while cultivating a group of outstanding scientific research talents, It has also made significant contributions to the new round of technological change and development of the country. For example, through the "Intelligent Aircraft Design and Manufacturing" scientific research project, Nanjing University of Aeronautics and Astronautics has brought together talents from Shanghai Jiao Tong University, Huazhong University of Science and Technology, Zhongshan University and other well-known universities. At the same time, Nanjing University of Aeronautics and Astronautics has carried out cooperation with leading domestic aviation enterprises such as Commercial Aircraft Corporation of China Ltd, which has achieved technological breakthroughs in the field of aerospace scientific research in China. It has laid a solid foundation for the subversive innovation of China's space science and technology, nurtured a large number of top-notch aircraft science and technology innovation talents, and created China's leading international standard aircraft science and technology research and development platform. By establishing the research project of "Yangtze River Ecological Civilization Center", Nanjing University has carried out relevant theoretical innovation and practical research on the major scientific research theme of "Yangtze River Delta integration". It has absorbed 17 formal research institutes, 15 preliminary research institutes and 12 ecological gover-

nance research centers. It is committed to the technological breakthroughs of sewage treatment, reprocessing of the surrounding river and ecological safety management, and has achieved remarkable results.

While noting the outstanding achievements in the deep integration of industry-university-research institutes along the Yangtze River Economic Belt, we cannot ignore many problems, such as: The awareness of colleges and universities to serve the society needs to be strengthened, the depth of universities-enterprise cooperation is insufficient, and the efficiency of transforming the achievements of industry-university-research education and research is not high. Solving these problems is the key to improving the quality of college personnel training, promoting scientific and technological innovation of enterprises, and driving the faster and better economic development of the Yangtze River Economic Belt.

2. The Impact of Deep Integration of Industry-University-Research on Enterprise Intellectual Capital in the Yangtze River Economic Belt

Today is the era of knowledge economy, and the foundation of knowledge economy is intellectual capital (Siegel et al., 2013). As a direct reflection of people's comprehensive ability, intellectual capital is a kind of intangible value and wealth, which plays a very significant role in promoting the development of enterprises and economic growth (Zheng & Wang, 2021). According to the survey and research, in recent years, the deep integration of industry-university-research in the Yangtze River Economic Belt has had a profound positive impact on the growth of intellectual capital strength and level of enterprises.

2.1. Help to Drive the Innovative Development and Benefit Transformation of Scientific Research Achievements of Enterprises

As an important development direction and focus of China's deepening reform of science and technology system, the deep integration of industry-university-research can promote the transition of China's economic growth mode from factor driven to innovation-driven at the macro level. In the micro aspect, strong innovation force can be generated through close connection between enterprises-universities-research institutions, thus accelerating the transformation of scientific research achievements of enterprises and driving the growth of economic benefits of enterprises. Taking Huazhong University of Science and Technology as an example, through in-depth integration of industry-university-research, it has established cooperative relations with more than 20 local industries and scientific research institutions in the Yangtze River Economic Belt to share talents, resources and technologies, and achieved major breakthroughs in 7 categories of intelligent and efficient manufacturing processes and core parts production technologies in the fields of automobile, aerospace, aviation and shipbuilding. A number of scientific research achievements have been awarded the "2020 National First Prize for Scientific and Technological Progress", which

has provided a great boost to the innovative development of many research enterprises and institutions along the Yangtze River Economic Belt and contributed to the rapid growth of the economic GDP of the Yangtze River Economic Belt.

2.2. Help to Improve the Core Competitive Strength and Human Capital Quality of the Enterprise

At present, although many small and medium-sized enterprises in China have certain impetus and vitality for innovation, problems such as lack of scientific research personnel, lack of scientific research technology, and shortage of scientific research funds have always been the key factors restricting the development of enterprises and affecting the improvement of their human capital. Through the deep cooperation between industry-university-research, the competitive strength of enterprises can be enhanced to a certain extent, and the growth of human capital of enterprises will be injected with strong impetus. Taking Chongqing Waterway Engineering Bureau of the Yangtze River as an example, through the deep integration of industry-university-research with Chongqing Jiaotong University, the establishment of the "production, University and research cooperation base" has cultivated a large number of scientific and intellectual talents, and made major technological breakthroughs in major national and local scientific and technological projects. With the support of the two-way transfer of talents and technologies from Chongqing Jiaotong University, Chongqing Waterway Engineering Bureau has made remarkable achievements in maintaining the smooth flow of the Yangtze River waterway, facilitating the construction of golden waterway and serving the development of the Yangtze River Economic Belt in recent years.

2.3. Help to Build a High-Quality Talent Training System under the University-Enterprise Cooperation Model

Universities can provide enterprises with innovative technical support and capable talent think tanks, but in order to "make the best use of people", it is necessary to find out what kind of talents enterprises need, so that universities can provide enterprises with appropriate talents and achieve seamless connection of human output. Under the background mode of university-enterprise cooperation, through the in-depth cooperation between universities-enterprises-research institutions, the targeted training of talents can be realized. On the one hand, the theoretical knowledge level of talents can be strengthened, and on the other hand, the practical ability of talents can be improved, so that under the guidance of specific scientific research objectives, they can enhance their abilities in real combat and become qualified. Truly can provide value and energy for the development of enterprises. For example, through cooperation with many leading enterprises, Nanjing University of Aeronautics and Astronautics has established provincial and ministerial collaborative innovation center, university-enterprise joint laboratory and joint scientific research team. In recent years, Nanjing

University of Aeronautics and Astronautics has carried out an average of more than 200 scientific research project cooperation every year, built a total of 10 university-enterprise education platforms and more than 70 talent practice bases, and trained a large number of high-quality qualified talents for various enterprises.

3. The Path to Improve Enterprise Intellectual Capital through the Deep Integration of Industry-University-Research in the Yangtze River Economic Belt

3.1. Create an Innovative Industry-University-Research In-Depth Integration System with Enterprises as the Main Body and Market as the Guidance

"To establish a technological innovation system with enterprises as the main body, the market as the guide, and the deep integration of industry-university-research" is a phrase repeatedly mentioned by Party and state leaders at the 19th National Congress and the Fourth Plenary Session of the 19th Central Committee, which provides a clear and clear direction for the development of the deep integration of industry-university-research (Feng, 2021). This requires enterprises-universities-research institutions to take industrial leadership as the basis in the process of industry-university-research cooperation. In accordance with the development direction of the current market economy, we should conduct in-depth and extensive cooperation on frontier and key technologies that need breakthrough at home and abroad (Santoro & Chakrabarti, 2012). Focusing on the strengths and capabilities of various participants, promoting the collaboration among small and medium-sized enterprises through extensive consultation, joint construction and sharing, improving the quality and level of talent training in universities, fully exploiting the resources and market advantages of enterprises-universities-research institutions in their respective fields, building a professional mass innovation space, and integrating it into the overall pattern of technological innovation and industrial entrepreneurship in the international field. Forming a batch of core scientific research and technology research achievements, breaking the foreign monopoly of the "key technologies", promoting the rapid transformation of the national economy, driving the modernization and upgrading of industries. Taking Jiangsu Jinshan Environmental Protection Group as an example, in order to further improve China's low carbon and environmental protection technology level, Jinshan Environmental Protection Group takes the initiative to cooperate with the College of Environment of Peking University. Relying on the resource advantages of both sides, Jinshan Environmental Protection Group has established the "Peking University—Jinshan Environmental Protection New Carbon Source Joint Laboratory", which is committed to the development of carbon source products and has made major breakthroughs in the research and development technology of biomass carbon source manufacturing. It has created a leading international level of biomass

carbon source made in China, which has better promoted the development of domestic sewage treatment industry, and also provided a strong internal power for the development goal of "carbon neutrality" advocated both at home and abroad.

3.2. Government Participation in Service Guidance, Major Scientific Research Projects as a Link to Promote Industrial Restructuring

In the process of promoting the deep integration of industry-university- research, we need to rely on the regulation of the market mechanism, but also need the active participation of government agencies (Zheng & Wang, 2021). Especially for the key generic technology and basic generic technology in the field of major research projects, more through the correct guidance of the government, to serve the deep integration of industry-university-research. With the promotion of the government, the industry-university-research cooperation alliance as the main carrier can be fully stimulated to achieve major breakthroughs in key technologies and core technologies and facilitate the rapid transformation and upgrading of China's major science and technology industry structure. The government can also focus on the specific development trend and direction of the deep integration of industry-university-research, formulate a series of supporting and encouraging policies, guide the continuous innovation of the deep integration mechanism of industry-university-research, clarify the role positioning of each responsible body, so as to promote better cooperation among the main bodies, so that the innovation body of the deep integration of industry-university-research can give full play to the huge driving force of "1 + 1 > 2". Enterprises also need to set up special funds for the deep integration of industry-university-research to provide a certain source of funds for the integration of enterprises-universities-research institutions and reduce the difficulties and risks of unilateral institutional investment, increase the willingness of enterprises to participate in the deep integration of industry-university-research. For example, in March 2022, according to the joint proposal of Guo Yuejin, Zhang Wentong and Yang Xixiong, members of the CPPCC National Committee of Hubei, the construction of "two centers" (science and technology innovation Center and Hubei East Lake Comprehensive National Science Center) in Wuhan is planned to be included in the national science and technology innovation strategy layout. If this proposal is actually implemented, the Hubei provincial government will issue policies and provide financial support for this goal. With the guidance and participation of the government, the deep integration of local industry-university-research will be further promoted smoothly and effectively, thus driving the Yangtze River Economic Belt centered in Wuhan, Hubei Province to make another leap forward in science and technology and economy. At the same time, it will help build a large number of new service platforms for science and technology innovation in Hubei and improve the development level of science and technology innovation in Hubei.

3.3. Establish a Scientific Research Evaluation System in Line with National Conditions and Improve the Personnel Incentive Mechanism

The purpose of promoting the deep integration of industry-university-research is to optimize the effective allocation of innovative science and technology resources, promote the pooling of innovation factors, accelerate the transformation of scientific research and innovation achievements, improve the level of enterprise innovation and development and market competitiveness, and at the same time, promote national economic growth and adjust the structure of the science and technology industry. However, in view of the current situation in our country, in the process of promoting the deep integration of industry-university-research, the scientific research achievements evaluation system is not particularly comprehensive, therefore, it is necessary to establish intellectual property courts as soon as possible, increase the support and protection of scientific and technological innovation, to ensure the healthy and orderly scientific and technological innovation activities from a legal level, to ensure that existing scientific and technological innovation achievements are not illegally eroded. In addition, it is necessary to establish a scientific and fair evaluation system of scientific research results according to the current national conditions of our country, so as to provide a good humanistic and academic environment for the carrying out of scientific research, fully mobilize the enthusiasm of young students in scientific research and arouse the initiative and enthusiasm of scientific research staff. Relevant information such as evaluation criteria, experts and evaluation results of scientific research achievements should be disclosed and publicized in a transparent manner in a timely manner, so as to fully guarantee the fairness and authority of the evaluation of scientific research achievements. In addition to improving the evaluation system of scientific research results, we should improve the incentive system of scientific research personnel. Incentive measures can be taken from both material and spiritual aspects to build a good atmosphere of respecting knowledge and talents in the whole society. It is also necessary to create a set of scientific research and technical personnel work results assessment mechanism, so as to stimulate the potential of researchers. On this basis, a free and reasonable human capital flow mechanism recognized by the market should be formed so that human capital can play its maximum function and effectiveness in the market economy environment.

3.4. Strengthen the Interaction between Universities, Enterprises and Scientific Research Institutions to Help the Training of Applied Talents in Universities

Through the deep integration of industry-university-research, to really promote the intellectual capital of enterprises, we must make talents alive. This requires enterprises, universities, scientific research institutions, government and other relevant subjects to strengthen communication and exchange, under the guid-

ance of the government's policy support, encourage talents of universities and scientific research institutions to go deep into the internal front-line work site, according to the ongoing national key scientific research projects, participate in the relevant links of technology research and development, project promotion, personnel services, etc. So as to improve the professional and technical level, social practice ability, scientific and technological service ability of young researchers. For scientific research institutions, through interaction with enterprises and their own participation in research projects, they can find technical problems in scientific research, and carry out special research around these problems, combine the strength of enterprises, solve the problems together, and achieve breakthroughs in key scientific research technologies; For teachers in colleges and universities, they can integrate the major scientific research knowledge obtained by participating in enterprise scientific research projects into classroom teaching, so as to innovate classroom teaching resources and materials, improve the teaching level and quality, and enable students to learn cutting-edge scientific research and technology knowledge; For enterprises, there are also many outstanding scientific research talents, who can be arranged to take temporary positions in universities and research institutions to teach young students in universities and institutions new technologies, scientific research technologies, theoretical knowledge and major technological achievements that have emerged in the process of production, research and development and application. It helps colleges and universities cultivate more application-oriented talents for enterprises and scientific research institutions, and also contributes to the innovative development of colleges and universities in the field of discipline and professional construction. The optimization and innovation of the talent training system of universities and the improvement of the scientific research level of scientific research institutions will not only benefit colleges and universities and scientific research institutions themselves, but also nurture the development of intellectual capital of enterprises and improve the core competitiveness of enterprises.

4. Conclusion

According to the survey and research, in recent years, the deep integration of industry, university and research in the Yangtze River Economic Belt has had a profound positive impact on the growth of intellectual capital strength and level of enterprises. The deep integration of industry, university and research can accelerate the innovation of enterprises in the field of scientific research and technology, accelerate the transformation of the achievements of the state and enterprises in major scientific research projects, improve the economic benefits of enterprises, serve social development, enhance the competitive strength of enterprises, and attract more think tanks and innovative technologies for enterprises. To build a high quality talent training system in colleges and universities will feed the human resources development of enterprises.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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