

University-Industry-Cooperation Integration and the Strategy of the Deep Integration of Professional and Technical Post Sequence Reform

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Abstract: The integration of university, industry, and cooperation(UIC) is an important way to transform scientific and technological achievements and national innovation. Aiming at providing suggestions used for reference on the UIC integration and the strategy of the deep integration of professional and technical post sequence reform, this paper starts with the domestic and international status quo of the integrated development of UIC, then analyzes the adaptability model of the integration of university, industry, and cooperation and the oil company model, and finally analyzes UIC integration and the adaptability of the oil company model from the two aspects of double-sequence reform and talent establishment.

1. Introduction

The integration of production, education, and research is the synergy and integration of functions and resource advantages of different social divisions of labor in scientific research, education, and production, and is the docking and coupling of technological innovation, middle and downstream. With the development of technology and the evolution of innovative forms, its special position in the innovation process has become more prominent. It has gradually formed with *university* as the basis, *industry* as the direction, and *cooperation* as the link, giving full play to their respective advantages and promoting the integration of technology and economy, which jointly carry out technological innovation activities, and realize the organic whole of the virtuous circle of scientific research-product-market-scientific research. As one of the significant ways to transform scientific and technological achievements and national innovation, UIC integration has been widely praised by various enterprises and scientific research institutions.

In foreign countries, colleges and universities, scientific research departments or institutions, and enterprises have high expectations for the combination of UIC and actively put them into practice. Forms like university-industry integration, industry-cooperation integration, university-industry-cooperation integration and other ways are developed, and main characteristics are as follows. The combination burgeons from small to large-scale, from simple to comprehensive, from single discipline to multi-disciplinary. Also, it can be used different forms under specific conditions. Additionally, governments of various countries are paying more and more

attention to the development of UIC integration projects. The governments around the world provide support through legislation, preferential fiscal and taxation policies, and other numerous ways. Here take the United States and Japan as major examples. The United States has formulated a strategy for continuing to improve investment in basic scientific research. Recent years, its focus is to further strengthen the position of universities in scientific research, support collaboration among scientists from universities, industry departments and government agencies, establish active partnerships, and increase research and cooperation. Development funds are invested in basic research, applied research and development. After entering the 1980s, Japan has paid more and more attention to the research of basic science. In recent years, it has vigorously advocated the integration of universities and enterprises. The implementation of the next-generation industrial basic technology research and development system, the central content is to ensure that Industry-management-learning (a kind of term for UIC) all forces cooperate with each other and give full play to their respective advantages. The United Kingdom, the former Federal Republic of Germany, and France all have similar government support.

In China, the cooperation of UIC started in the last century and has achieved certain results since its development, mainly reflected in four aspects. ①The policy system for UIC has become gradually thorough, including sufficient policy documents and abundant policy-making entities. The number of policy documents is more than 2000 policy document information and 25 policy forms. It's wealthy in policy-making body, including the constitution, basic law, departmental law, autonomous regulations, international treaties, conventions, speeches, reports, and resolutions of important leaders, etc. As for the perspective of the main body of policy promulgation, the Ministry of Science and Technology and the Ministry of Education are the main forces in policy formulation, accounting for 17.29% and 15.06% respectively, providing policy guarantees for the advancement of UIC collaborative innovation. ②The investment in cooperation has increased steadily. With the in-depth implementation of the innovation-driven development strategy, domestic academic-research cooperation has developed rapidly. Also, the government, enterprises and institutions have been steadily increasing the funding support for colleges and universities. In 2018, the number of the national fiscal science and technology expenditure was 951.82 billion yuan, which was an increase of 113.46 billion yuan over the previous year, and an increase of 13.5%. The ratio of fiscal science and technology expenditure to the national fiscal expenditure of the year was 4.31%, which was an increase of 0.18 percentage points over the previous year. Among them, the number of the central fiscal science and technology expenditure was 373.85 billion yuan, an increase of 9.3%, accounting for 39.3% of the fiscal science and technology expenditure. Also, the local fiscal science and technology expenditure was 577.97 billion yuan, an increase of 16.5%, accounting for 60.7%. ③The output of technological achievements has increased rapidly. In recent years, China 's innovation capabilities have rapidly improved, technology market has developed rapidly, and the volume of technology contract transactions has increased year by year. According to data from the Ministry of Science and Technology, the turnover of China's technology contracts rose from 857.7 billion yuan in 2014 to 1.78 trillion yuan in 2018, an increase of 106.98%. ④A large number of cooperative innovations have emerged. Here take the China UIC Cooperation Innovation and Promotion Award established by the China UIC Cooperation Promotion Association as an example. At of the end of 2018, the China UIC Cooperation Promotion Award had selected a total of 1 106 awards, of which 186 were in 2018, one less than in 2017, but in general, the awards showed an upward trend from 2010 to 2018.

2. The Uic Integration and Adaptability Model Analysis of Oil Company Model

Oil company mode refers to the mode adopted by enterprises or regions closely related to

petroleum, including oilfield enterprises, petroleum technical service companies, petroleum equipment industry and Daqing Oil City. This section discusses the factors that should be paid attention to when the integration of UIC is applied to the adaptation process of oil company enterprises or regions, and the factors that are not suitable should be avoided.

Foreign literature on this topic mainly includes UIC integration and adaptability analysis of oilfield enterprises, petroleum technology service companies, petroleum equipment industry and Daqing High-tech Zone. Foreign literature mainly emphasizes the UIC cooperation of petroleum technical service companies (hereinafter referred to as oil service companies)¹. Taking international famous petroleum technical service companies such as Schlumberger, Baker Hughes and Halliburton as examples, their cooperation mode is gradually developing from single educational support cooperation to all-round cooperation, and It has four characteristics, such as the same technology strategy, the establishment of management departments to provide organizational support, the scientific research cooperation paying more attention to the basic and pioneering, and the cooperation with comprehensive petroleum companies. Generally speaking, the cooperation between oilfield service companies and universities and scientific research institutions usually starts from the establishment of scholarships, donations, exchanges and visits and gradually develops into all-round cooperation in education support and scientific research, such as the joint establishment of research institutions and the industrialization of joint research results. Schlumberger's cooperation with Tsinghua University and Peking University in China basically follows this path. Since 2003, Schlumberger has cooperated with The School of Software and The School of Engineering of Peking University. In the initial stage, the cooperation is mainly in scholarship establishment, talent exchange, joint training and other aspects, and then gradually has the cooperation in scientific research. Since 2002, Schlumberger has cooperated with the School of Software, Tsinghua University, and now it has become the main internship exchange and research cooperation enterprise of the School of Software. Baker Hughes inc. in 2005, with the Yangtze university *the oil and gas resources and exploration technology key laboratory of the Ministry of Education* formally signed a cooperation agreement, international education support, academic communication, after both sides of close contact, to strengthen the cooperative relationship. At present, scientific research cooperation in some frontier technologies has been gradually carried out. UIC integration with the company's technology strategy, such as Baker Hughes' collaboration with Los Alamos National Laboratory (LANL) on micro-hole drilling technology. For instance, Halliburton has a director of global University affairs, who is responsible for cooperation and exchanges with universities and research institutions around the world. Since 2002, Exxon·Mobil and four other powerful oil service companies have committed \$87.4 million to research projects supported by the united Integrated Petroleum Corporation (UIC), which has benefited from numerous research results. At home, Daqing High-tech Zone, oilfield enterprises and petroleum equipment industry have also carried out UIC integrated cooperation. Daqing is a resource-based city with petroleum and petrochemical as pillar industries, and the high-tech zone is the core area of the high-tech industry in Daqing. Enterprises in the high-tech zone can make up for the lack of their own research and innovation ability through UIC cooperation with universities and scientific research institutions, and improve the regional independent innovation ability. Through Daqing University City, a benign adaptation mode of *developing enterprises relying on universities* has been formed. In the petroleum equipment industry, Risong Zou et al. (2020) took the patent perspective as an important research method of UIC collaborated innovation, and found that optimization of UIC network environment and improvement of enterprises' innovation ability should be fully considered in the adaptation

¹ Oil service companies mainly provide comprehensive oil companies with technical services in the process of oil and gas exploration and development. Therefore, technology is the foundation and driving force for the survival and development of oil service companies.

process of petroleum technology and UIC organization.

The integration mode of *University-industry-cooperation and application* implemented by SINOPEC North China Oil and Gas Company takes the benefit development of oil and gas fields as the goal and takes *University-industry-cooperation and application* as a system-plan, the whole advancement, optimize the top-level design, adopted to establish efficient management system of science and technology, more professional collaborative research and innovation projects and roll back mechanism, clear responsibility, joint training mode, fair and reasonable scientific research evaluation system to promote the integration of production, and the adaptive process of oil field enterprise, has obtained the good effect.

3. Actual Effects of the Uic Integration and Professional and Technical Post Sequence Reform

Some enterprises are constantly discussing and practicing the in-depth integration of UIC and the reform of professional and technical post sequence. It is necessary to fully stimulate the enthusiasm of professional and technical personnel according to the strategic development goals of enterprise development. The effective fusion method and approach are mainly shown in the following two aspects.

The first is the *double-sequence* reform. At present, this reform has been steadily promoted in 7 research institutes directly under CNPC and 40 enterprise research institutes. To realize the separation of *technology management* and improve the efficiency of human resources allocation, the reform of professional and technical post sequence provides two development paths of technology and management, and makes clear the division of responsibilities and rights between management sequence and technical sequence. It has broken the bottleneck of career promotion and pointed out the way for the development of *expert talents*, so that technical talents can focus on scientific research and get better career development by doing scientific research well and deeply. In terms of salary and treatment, the average income of the employed professional and technical personnel has increased to a certain extent compared with that before employment. The income of the first-level technical experts, second-level technical experts, first-level engineers and second-level engineers of the enterprise is roughly corresponding to the income of the main division level, deputy division level, chief division level and deputy division level respectively. The salary level of professional and technical personnel has been improved, the salary can be increased or decreased, and the dynamic management of posts has been realized. This reform effectively stimulated the enthusiasm of professional and technical personnel and initially established a relatively complete professional and technical personnel management system.

The second is to *establish the institute of talents*, deepen the construction of professional and technical personnel management system. According to the *three-dimensional conical model of career development*, the characteristics of high-level needs of professional and technical personnel in state-owned enterprises' scientific research institutes are as follows: from the point of survival needs, they pay more attention to spiritual motivation. In terms of relationship needs, it lays more emphasis on the carrier of knowledge communication. In terms of achievement needs, talents pay more attention to the embodiment of their own value and achievement in the industry. In terms of the need for rights, they are more inclined to control the allocation of resources and the realization of scientific research objectives. Sequence conversion mechanism part-time expiry policy. According to these characteristics, the integration of production, and professional and technical posts sequence reform measures include: post rank and quantity control, professional and technical posts rank from high to low level 0, respectively, for group experienced senior technical experts and senior technical experts, enterprise level of technical experts, secondary technical experts and engineers, 2 engineers and 3 engineers, engineers, technicians, the number of posts to implement

the total control. Post setting, according to the principle of post level setting and quantity control, combined with the actual needs, industry characteristics, business scale and complexity, scientific research (production) capacity, organizational form, etc., set up professional and technical posts, requiring the establishment of *collective attack* team building post system. Salary incentive, based on professional and technical personnel positions, explore the establishment of a performance-based salary system guided by the labor market price, based on post evaluation and performance evaluation, reflecting post value, ability level, and work performance in a fair, reasonable, standardized and orderly manner. Performance assessment: professional and technical staff adopt the key performance indicator assessment method to carry out tenure (comprehensive) assessment and annual (performance) assessment, sign performance contracts, clarify assessment indicators, objectives and weights, implement compulsory distribution of assessment results, cash performance pay strictly according to the assessment results, and reasonably open the gap. The sequential transfer mechanism encourages professional and technical personnel to choose the career development channel suitable for their own characteristics. On the premise of meeting the post conditions, the management channel personnel are allowed to transfer horizontally to the professional and technical channel, but they need to go through the ability evaluation and performance assessment of the professional and technical evaluation committee, and can no longer hold administrative posts. Part-time transition policy, professional and technical post sequence set transition reform policy, the longest period for 3 years, the transition period, operation and management personnel engaged in the work of scientific research management may concurrently hold the position of enterprise technology experts, with professional and -+/technical work is given priority to, accounts for professional and technical positions, not enjoy the benefits of professional and technical posts, after the transition period, should be in professional technical and management of the sequences Choose a post, not part-time.

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