Research on the Dynamic Mechanism of Modern Industrial Colleges

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Abstract: An industrial college is a school-running mode adopted by universities and enterprises to deepen the cooperation between industry, university, and research. The dynamic mechanism of its construction is to establish a cooperative power system from the macro, meso, and micro levels, including the government's administrative power, legal force, and so forth. The economic force, contract power, competitiveness, and so forth. The social contract force, cultural power, and communication influence, and so forth, which constitute the logical mechanism diagram of power transmission and energy transformation, to lay the foundation for the mechanism design and research of modern industrial colleges. Through a review and analysis of relevant literature, this study discusses the different types and functions of dynamic mechanisms and the connotation characteristics of industrial colleges, classifies them according to the sources of forces, and constructs a "force system diagram" to analyze the cooperative dynamics of industrial colleges from the macro, meso, and micro levels. The results show that it is of great significance to make full use of various driving forces such as government, market, and society to construct a reasonable mechanism design to promote the innovation and development of modern industrial colleges. This study provides a useful reference and enlightenment for the practice of modern industrial colleges and provides a theoretical basis and research path for future related research.

1. Introduction

As an innovative education model, improving the quality of higher education and promoting industrial development are substantial. The dynamic mechanism plays an important role in the modern industrial college and a key role in the development and success of the college. The dynamic mechanism can be understood as the interaction between the internal factors that promote the development of the college and the external environment. This includes the organizational structure, management system, talent training model, and partnership[1]. It can promote cooperation between the college and enterprises, promote innovation and development, cultivate high-quality talent in line with market demand, and contribute to industrial development and economic growth. Therefore, strengthening the research and practice of dynamic mechanisms for the sustainable development of modern industrial colleges is of great significance.

In the construction of modern industrial colleges, building the relationship between universities and enterprises is a relatively complex systemic problem[2]. At the logical level, the strategic cooperation design between the two sides requires universities and enterprises to be interdependent, promote each other, and endorse technological innovation, governance innovation, and education innovation. Conversely, at the practical level, there are phenomena such as low interaction between

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universities and cooperative enterprises and a low degree of substantive involvement. In terms of depth of cooperation, due to the lack of motivation, the enterprise side often cannot achieve the expected goal of the design of an industrial college. In terms of joint training of talents, the relatively lagging talent training mode of colleges and universities cannot meet the qualification requirements of enterprises for graduates to work. Regarding scientific and technological innovation and technological research, problems such as “two skins” and “mismatch” between the R&D ability and social serviceability of colleges and universities as the main body of innovation and the needs of enterprises exist. The key to solving these problems lies in the different development logics followed by each subject in school–enterprise cooperation, and there are differences in cognitive structures and values, leading to insufficient cooperation motivation and poor operation mechanisms of industrial colleges[3]. Therefore, the construction and development of modern industrial colleges must clarify the rights and obligations of universities and enterprises in cooperation, and clearly define the power driving mechanism, human resource arrangement, financial resource investment, and conditional resource allocation of the two sides in the cooperation through a scientific, reasonable, and concrete agreement in line with the actual situation.

By reviewing and analyzing relevant literature, this study explores the different types and functions of the dynamic mechanism of modern industrial colleges and the connotation characteristics of industrial colleges and classifies them based on the sources of forces and constructs and analyzes the “force system diagram” of the cooperative dynamics of industrial colleges from the macro, meso, and micro levels, including the relationship between various forces and various stakeholders, the roles between members within the subject, and various power transmission and energy transformation processes[4]. To provide useful enlightenment and guidance for the development of industrial colleges, this study aims to deeply understand the role and significance of dynamic mechanisms in modern industrial colleges.

2. Research on the type of dynamic mechanism of modern industrial colleges

The social operating mechanism is an organic system in which all constituent elements are interconnected and influenced, and the dynamic mechanism is the fundamental reason for the emergence and change of things[5]. The dynamic mechanism refers to the principle of action, the conduction process, and the internal relationship of various dynamics in the development of things, and its essence is to reveal how the parts of things interact with each other to achieve the optimal operation of the whole.

It is the mission and mission of the modern industrial college to serve the needs of regional economic and social development and industrial transformation, deepen the integration of science, industry and education, government, school, and enterprise cooperation, and promote the innovation and reform of talent training mode in the new era[6]. Industrial colleges are the main way to promote the integration of science, industry, and education, which should be considered from the macro, meso, and micro levels, including the types and compositions of various forces.

2.1 Macro level

At the macro level, the construction and development of industrial colleges will be driven by three forces, namely, administrative power, legal power, and economic power.

2.1.1 Administration

The external driving force of the integration of industry and education mainly refers to the driving force or pressure outside the subsystem of colleges and universities and the subsystem of enterprises, which promotes the deepening of the integration of industry and education between colleges and enterprises, mainly including the driving force of the government and market competitiveness[7].

2.1.1.1 Policy-oriented driving force

The policy-oriented driving force is the embodiment of the will of the party and the state, and

plays a role mainly through the introduction of policies, strengthening planning, and improving the legal system. The policy-oriented driving force for the integration of industry and education in colleges and universities is mainly reflected in three aspects:

The first is ideological and conceptual guidance. The government continues to emphasize the importance of the integration of industry and education, from school–enterprise cooperation to the integration of industry and education, from the field of education to the field of industry and constantly gives the strategic position of the integration of industry and education reform to a new height[8]. General Secretary Xi Jinping highlighted that "cultivate a fertile soil for the growth of talents, so that the roots of talents are more developed" and promoted the construction of modern industrial colleges to implement the concrete embodiment of General Secretary Xi Jinping's important exposition on education[9]. The state attaches great importance to the integration of industry and education and has successively issued a series of documents such as the "Several Opinions of the General Office of the State Council on Deepening the Integration of Industry and Education" and vigorously promotes the construction of a new pattern of school–enterprise dual-subject development through the way of modern industrial colleges, promotes talent training, scientific and technological innovation, and social services in colleges and universities, and realizes the development of higher education and the national and regional economic and social development goals at the same frequency and resonance.

The second is to guide the development environment. The government has continuously introduced measures to encourage the implementation of the integration of industry and education, from financial subsidies to tax incentives and from financial support to land incentives, and has continuously provided convenient conditions for the integration of industry and education.

The third is to guide in the direction. The government continues to build demonstration bases for the integration of industry and education, guides institutions of higher learning and enterprises to achieve in-depth integration in various aspects from teaching places to teaching content, and constantly highlights the direction of the integration of industry and education[10].

Therefore, the policy-oriented driving force can be said to be the key force in promoting the integration of industry and education in colleges and universities.

2.1.1.2 Competitive pressure in the market

To cultivate high-quality talent with greater market competitiveness, colleges, and universities must enhance the quality of their education[11]. Therefore, the pressure of market competition has forced the implementation of school–enterprise cooperation and the integration of industry and education. For colleges and universities, the pressure of market competition is mainly reflected in the pressure of competition for running schools, including the reduction of students, the transformation of colleges and universities, the homogeneity of colleges and universities, and the level of talent training. For enterprises, the pressure of market competition is mainly reflected in the pressure of scientific and technological innovation and core competition for talents[12]. However, the long-term lack of attention to human resource development has led to the development of human resource structure and the demands of industrial transformation and upgrading. Therefore, in the path of enterprise transformation and upgrading, innovating the enterprise development system and accumulating high-quality talents have become an important choice. Without the support of a large number of high-quality human resources, industrial transformation and upgrading will be unsustainable.

2.1.2 The rule of law

2.1.2.1 School–enterprise cooperation thrust

The national and regional economic and social development must drive the government to promote, encourage, and even organize enterprises and universities to perform school–enterprise cooperation, to promote the positive role of schools and enterprises in the quality of talent training, scientific and technological innovation, and social services, thus the government departments are stakeholders in industrial colleges[13]. According to the development goal of the integration of

industry and education, government departments develop relevant policies and regulations, such as the introduction of school–enterprise cooperation regulations and the establishment of school–enterprise cooperation funds to provide legal guarantee and financial support for school–enterprise cooperation[14]. Government departments provide channels for information exchange and cooperation between schools and enterprises by building school–enterprise cooperation platforms, such as establishing school–enterprise cooperation networks and holding school–enterprise cooperation forums.

2.1.2.2 Educational philosophy influence

Ideas are the precursor to action. Modern higher education necessitates strengthening the cultivation of students' ability to use science to solve practical problems, which is an educational model based on basic theories and closely linked with industrial development.

At present, the common educational concepts in higher education are as follows: First is the concept of whole-person education. The core idea of this educational philosophy is to educate the human being as a complete individual, emphasizing the cultivation of the whole human being. The reform of general education is the concrete practice of the idea of whole-person education[15]. The second is the concept of mass education. The core idea of this educational concept advocates that education is the right enjoyed by the majority, and the expansion of college enrollment is the concrete practice of the concept of mass education. The third is the concept of polycentric education. The core idea of the polycentric education concept is to educate people with "multiple subjects," jointly assume the responsibility of talent training, and provide their own unique educational environment and resources, aiming to achieve a win–win situation for all parties through the collaborative co-governance of multiple subjects[16]. This concept provides space for the development of the integration of industry and education. Driven by this concept, and after more than 10 years of hard work, the current colleges and universities have initially formed a basic teaching system characterized by the integration of industry and education.

2.1.3 Economic power

(1) First, industrial colleges can promote the integration and mutual promotion of scientific and technological innovation and teaching innovation[17]. Scientific and technological innovation and teaching innovation are mutually reinforcing and mutually reinforcing. With the development of science and technology, such as the Internet, artificial intelligence, big data, and other new technologies in the field of teaching, the teaching content has become richer and more diverse, and the teaching methods are more flexible and changeable. For example, the application of virtual reality technology allows students to learn and practice in a simulated environment, thus enhancing the effectiveness of teaching. Furthermore, teaching innovation exerts an impact on scientific and technological innovation, and teaching innovation not only cultivates more talents with innovative spirit and practical ability but also provides a steady stream of intellectual support for scientific and technological innovation. Simultaneously, through teaching innovation, the latest scientific and technological achievements and knowledge can be passed on to students, stimulate their enthusiasm and interest in innovation, and cultivate more scientific and technological innovation talents.

(2) Second, industrial colleges can promote the sharing of school–enterprise resources. Through the platform of an industrial college, colleges and universities focus on advantageous disciplines and majors, gain an in-depth understanding of the development of cutting-edge industrial technology of relevant leading enterprises, and obtain more production practice experience and cutting-edge information of disciplines, to further adjust the discipline settings, optimize the curriculum settings, and improve the level of discipline construction and the quality of education and teaching[18]. For enterprises, through an industrial college, the use of colleges and universities have strong scientific research strength and talent advantages, relatively complete scientific research equipment, experimental facilities, and systematic scientific research operation system, combined with the enterprise's own research and development resources, to jointly tackle the advanced technology and solutions for industrial development.

(3) Finally, industrial colleges can promote a seamless connection between the education chain

and the industrial chain. Through the joint development of professional planning, the development of talent training programs, the joint development and construction of courses, and the joint organization of teaching implementation and internship training, industrial colleges have truly realized the "dual subject" education of schools and enterprises, enabling schools to better understand the needs of enterprises and provide enterprises with talents that are more in line with their needs. Enterprises and schools rely on industrial colleges to integrate the resources of both sides, jointly build a platform for technological innovation and transformation, jointly build a public training base, jointly carry out technical research and achievement transformation, give full play to the demonstration influence of industry–university–research cooperation, and better serve the development of local industries, which not only helps to improve the technical level of enterprises but also helps to promote the development of scientific research of the school[19]. The industrial college has realized the coordination and linkage of government, school, industry, and enterprise, effectively realized the sharing of technology, talents, information, and resources between government, school, industry, and enterprise, optimized and innovated the resource allocation model, promoted the organic connection of education chain, talent chain, industrial chain, and innovation chain, and promoted the in-depth development of the integration of industry and education.

2.2 Mesoscopic level

At the mesoscopic level, this paper studies the working mechanism of each subject of modern industrial colleges in the process of cooperation to realize the stable and balanced development of the structure of modern industrial colleges.

(1) The construction of an industrial college is guided by the idea of a sense of social responsibility. An industrial college also highlights cultivating students' comprehensive quality and professional ethics, improving students' sense of social responsibility and teamwork ability, and developing highly skilled talents with comprehensive quality[20]. As educational units, colleges and universities undertake the historical mission of inheriting culture and cultivating talents and should pay attention to practical teaching, cooperate with enterprises, jointly develop courses and projects, or set up practice bases to enable for students to experience and understand social responsibility in practical work. In terms of enterprises, in the in-depth cooperation with universities, we actively convey and share the concept and values of corporate social responsibility, effectively enhancing the social reputation and image of enterprises. Simultaneously, all parties involved in cooperation should earnestly fulfill their social responsibilities and cultivate students.

(2) The construction of industrial colleges is based on technological innovation and talent interaction. The technical interaction between universities and enterprises should be based on mutual trust, complementary advantages, and common development. Colleges and universities have rich technical resources and talent advantages, while enterprises have the advantages of market, capital, and industrialization[21]. The two sides can complement each other's advantages and, through an industrial college in the field of technology, can establish long-term and stable cooperative relations, sign cooperation agreements, clarify cooperation goals and responsibilities, conduct technical research, product development, achievement transformation and other work, and jointly promote technological innovation and industrial upgrading. Universities may transfer research results or technological achievements to enterprises or grant technology licenses to enterprises, and enterprises will carry out industrial production and promotion[22]. Universities and enterprises can jointly fund the construction of R&D institutions relying on industrial colleges, specializing in technical research and product development, and improve the efficiency of technological innovation and the conversion rate of results. Through the cooperation of industrial colleges, we can also obtain national and local financial support to promote the coordinated development of talent training, technological research, and industrial innovation.

2.3 Micro level

At the micro level, the individualized behavior of "people" participating in the integration of industry and education has a key impact on the formation of the organizational mechanism of

modern industrial colleges.

First of all, cultivating high-quality talents is the core goal of building an industrial college. The construction of an industrial college aims to better meet the needs of enterprises for high-quality engineers and promote the integration of industry and education and the innovation among talent training models. Through in-depth cooperation with enterprises, an industrial college can closely integrate educational resources with industrial resources, provide students with practical opportunities closer to the actual work environment, and cultivate more high-quality talents with practical ability and innovative spirit. In an industrial academy, students can be exposed to the latest technology, equipment, and processes, understand the actual needs and operating models of enterprises, and learn more practical skills and experience. By cultivating more high-quality talents with practical ability and innovative spirit, we can better meet the needs of enterprises and promote the development and upgrading of the industry.

Second, the training of industry engineers is an important goal of the construction of an industry college. An industrial college is committed to providing students with a comprehensive educational experience by building a system for cultivating innovation ability in the field of practice, focusing not only on the impartation of theoretical knowledge but also on the cultivation of practical skills. Through in-depth cooperation with enterprises, an industrial college can provide students with practical opportunities closer to actual work scenarios, help them master practical skills and experience, and improve their ability to use science to solve practical problems, innovative practical ability, innovative thinking, and entrepreneurial spirit. Through school–enterprise cooperation, students can get in touch with the latest technology, equipment, and technology, understand the actual needs and operation mode of enterprises, learn more practical skills and experience, realize the high-quality training of industry engineers, help meet the needs of enterprises, and promote the development and upgrading of the industry[23].

Finally, the cultivation of high-level double-qualified teachers is the expected goal of the construction of industrial colleges. Double-qualified teachers refer to teachers who have both theoretical and practical teaching skills and who can combine theory and practice to provide students with a teaching experience i.e., closer to the actual work environment. In an industrial college, high-level double-qualified teachers can better integrate industry needs and industrial development into teaching, help students master practical skills and experience, and improve their practical ability and innovative spirit[24]. Through in-depth cooperation with enterprises, an industrial college provides teachers with more practical opportunities and training resources to help them continuously improve their practical ability and professional quality. Moreover, an industrial college encourages teachers to participate in industry technology research and project development, promotes collaborative innovation of industry, academia, research, and application, and improves teachers' scientific research ability and comprehensive quality.

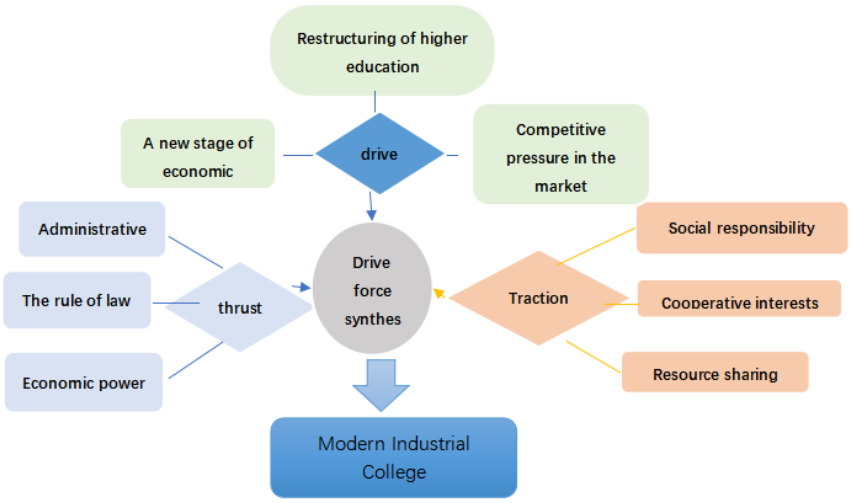

Fig. 1 Department of power of an industrial college

Therefore, through industrial colleges, the interdependence between universities and enterprises can be enhanced, and the seamless connection between the education and industrial chains can be realized. Therefore, the greater the motivation for cooperation between the two, and vice versa. Figure 1 shows the "force system diagram" of an industrial college.

3. Conclusions

A modern industrial college is the product of the deep integration of industry and education in higher education under the new situation. In the construction of modern industrial colleges, we must always adhere to the principle of "insisting on industry, education-oriented, integration of industry and education, and innovation and development"[25]. To achieve win–win cooperation between universities and enterprises and promote the characteristic development and transformation of colleges and universities, we will continue to innovate the integration model of industry and education in higher education, promote the construction of industrial colleges, strive to realize the seamless connection between the education and industrial chains. Give full play to the dynamic mechanism factors such as policies, market demand, resource sharing, and collaborative innovation, promote the integration of industry and education, the combination of engineering and learning, and collaborative innovation.

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References

[1] Wang Yulong, Guo Fuchun. The realistic pattern and path choice of deepening the integration of production and education in colleges and universities. Vocational Education Forum, 2021, 37(02): 40-45.

[2] Zhou Biqiong. Analysis on the dynamic mechanism of integration of production and education in application-oriented undergraduate colleges. Journal of Xiangnan University, 2020(12):102-106.

[3] Chen Xiaoqing. Research on the dynamic mechanism of integration of industry and education in colleges and universities in Guangzhou[D].Guangdong Normal University of Technology, 2021

[4] Hu Tingting. Research on the integration of production and education in Yangzhou colleges and universities from the perspective of dynamic mechanism. Journal of Jiangsu Vocational and Technical College of Architecture, 2021, 21(3):58-61.

[5] Liu Xiaobei. Incentive mechanism of school-enterprise collaborative education from the perspective of demand analysis [J].Education and Career, 2018(12):55-58.

[6] Zhang Li, Yang Haihua, Yan Jianhui. Construction of four-dimensional dynamic mechanism of school-enterprise collaborative education from the perspective of collaborative innovation [J]. Shandong Chemical Industry, 2020.49(2):164-165.

[7] Dong Shugong, Ai Di. Integration of production and education enterprises: value orientation, operation mechanism and cultivation path. China Vocational and Technical Education, 2020(01):56-61.

[8] Ma Weimin. The concept and path of the construction of industrial college: based on the

practical exploration of Gree Pearl Industrial College [J].Lifelong Education Research, 2021(4):47-52.

[9] Zhang Jianyun. The reconstruction of the relationship between government, school and enterprise will deepen the construction of the dynamic mechanism of the integration of enterprise production and education. China Vocational and Technical Education, 2021(22):54-59

[10] Yu Qiding, He Zhen. The essence of vocational education. China Vocational and Technical Education, 2009 (27):5-10.

[11] Liu Xiaomei, Liu Bin. Path model and realistic thinking of deep integration of production and teaching in vocational education. China Vocational and Technical Education, 2020(19):26-32.

[12] Li Xiaojie. The institutional logic of industrial college and its policy significance. Vocational and Technical Education, 2015, 36(31):49-52.

[13] Zhu Weihong. Research on the Construction of Industrial Colleges in Local Undergraduate Colleges under the Background of New Engineering [J]. Journal of Higher Education Management, 2018,12(2):30-37

[14] Liu Xianghong. Research on the Construction of Industrial College of New Undergraduate Colleges: A Case Study of Fujian Province [J]. Journal of Fujian Jiangxia University, 2020, 10(1):104-112

[15] Nie Wei. Theory cognition and practice shaping of industrial college. Vocational Education Forum, 2021(9):26-30

[16] Lin Shibin. Industrial college organizational change and system logic. Guangdong Vocational and Technical Education and Research, 2021(4):172-174

[17] Cai Ruilin. Cultivating the key to the construction of the industrial college of the property rights university-enterprise community. Modern Education Management, 2018(2):89-93

[18] Liu Zhouhai. Research on the construction of goal-driven education mechanism based on “double synergy” in industrial colleges [J].Journal of Higher Education, 2021(4):193-196.

[19] Liu Guomai. The construction path of new industrial college based on "three-way integration" training applied talents. Research on Higher Engineering Education, 2019(1):62-66

[20] Zhu Yanfeng. Exploration and Practice of Collaborative Education Model Based on Industrial College [J]. China Polytechnic, 2020(20):58-63

[21] Yu Guohong. Research on the construction path of modern industrial college based on the deep integration of industry and education [J].Theory and Practice of Innovation and Entrepreneurship, 2022(7):193-196.)

[22] Li Xue. Market-oriented School-Enterprise Co-construction of Industrial Colleges: Logic, Value and Path [J]. Education and Career, 2022(3): 35-41

[23] Xie Xiaozhen. Research on the mechanism of integration of industry and education and its mechanism design path [J].Research on Higher Engineering Education, 2019(5):81-87.

[24] Li Tuoyu, Shi Jincheng. Literature Review and Prospect of New Engineering: Based on the Analytical Framework of “Five Hes” [J]. Higher Engineering Education Research, 2018(4): 29-39

[25] Hurwitz, Ritter, ed. Tian Guoqiang, et al. trans. Economic mechanism design. Shanghai: Gezhi Publishing House, 2009:4-5