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Research on Promoting the Deep Integration of Innovation Chain, Industry Chain, Capital Chain, Talent Chain in Xi'an

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Abstract: Shifting from high-speed growth to high-quality development is the distinctive feature and inevitable requirement of China's economic development in the new era. It emphasizes the deployment of innovation chain around the industrial chain, improves the capital chain around the innovation chain, and makes a comprehensive deployment to improve the talent development mechanism. In the report, it is proposed to promote the deep integration of the innovation chain industrial chain capital chain talent chain (referred to as the "four chains"). Industry is the carrier of economic development, innovation is the first driving force leading development, capital and talent as two key support, the deep integration of the "four chains" is not only an important measure to build a new development pattern, but also an important support for building a modern system. Based on this, on the basis of analyzing the actual state, problems and obstacles of Xi'an's "four-chain" integration development, this paper formulates the path design of Xi'an's "four-chain" deep integration, and designs the driving mechanism of Xi'an's "four-chain" deep integration.

1. Introduction

Promoting the deep integration of innovation chain, industrial chain, capital chain and talent chain (hereinafter referred to as the "four chains") is of great significance to high-quality economic development. Its essence is to reduce various barriers encountered when innovation factors flow across organizational boundaries, improve allocation efficiency [1-2], better play the main role of enterprises in scientific and technological innovation, and enhance the overall efficiency of the national innovation system [3-4]. The report of the Party's 20th National Congress proposed to "promote the deep integration of the innovation chain industrial chain capital chain talent chain". "Four-chain" integration is not only an important starting point to promote the marketization of factors and build a new development pattern, but also an internal requirement to improve the overall

efficiency of the national innovation system, its essence is to effectively allocate various factors under the guidance of the government and the role of the market mechanism [5-7].

From a relatively macro perspective, the deep integration of the "four chains" means that technology, industry, finance and talent have formed a development pattern of synergy and complementarity, mutual empowerment and overall optimization. The innovation chain is composed of basic research and applied research, technology research and development, industrialization and commercialization of new products or new processes [8-9], which reflects the transformation process from scientific value to technological value and then to economic value. The industrial chain refers to the chain process formed by the production and processing of the final product. Capital chain is the whole process of capital input, capital operation and capital withdrawal. Talent chain is a chain talent collection formed by the transmission and correlation of industrial knowledge, skills, achievements and experience. The supply-demand relationship of different dimensions and the market-oriented connection mechanism are the engines that pull the "four chains" to be interrelated and deeply integrated. The relationship between the "four chains" is shown in Figure 1.

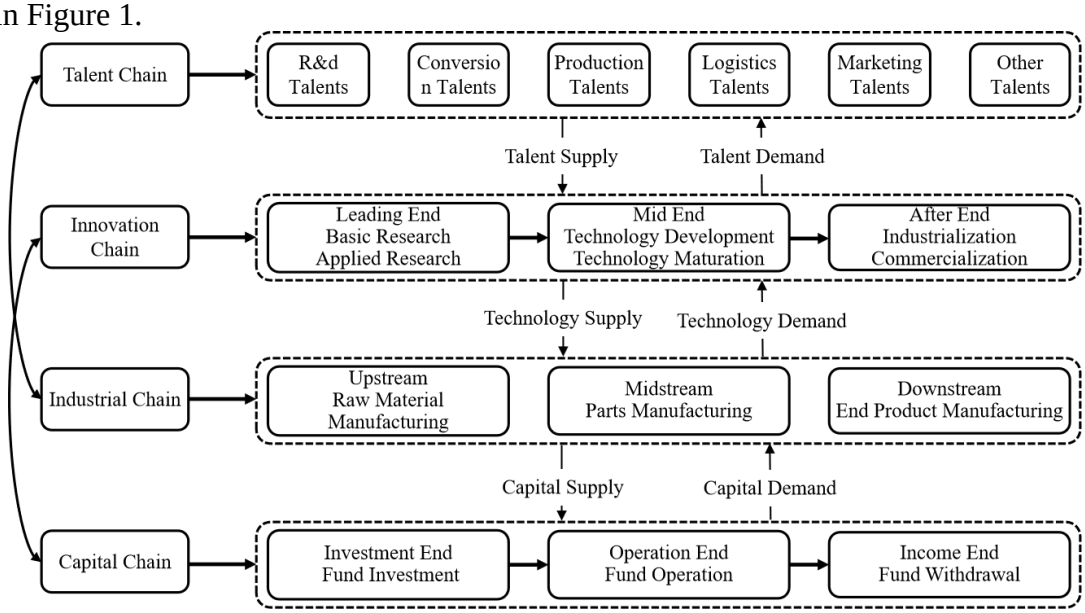

Figure 1: The Relationship between the "Four Chains"

In the context of fierce global economic competition and rapid scientific and technological development, the deep integration of innovation chain, industrial chain, capital chain and talent chain has become the key to regional economic development. However, in the process of promoting the deep integration of the "four chains", Xi'an is still facing a series of problems to be solved. First of all, in terms of the innovation chain, although Xi'an has rich scientific research resources and innovation achievements, the transformation efficiency of scientific and technological achievements is not high, and the industry-university-research cooperation mechanism is not perfect, resulting in many innovation achievements difficult to be quickly transformed into actual productivity [10]. Secondly, the development of the industrial chain has problems such as insufficient optimization of the structure, insignificant industrial cluster effect, and insufficient coordination between upstream and downstream enterprises, which restricts the overall competitiveness and sustainable development ability of the industry. Moreover, in terms of the capital chain, the ability of financial services to the real economy needs to be improved, the matching degree of capital investment and industrial development needs is not accurate enough, and the problems of difficult and expensive financing for small and medium-sized enterprises are still prominent, affecting the innovation and development of enterprises. In addition, in terms of talent chain, although Xi'an has many

universities and scientific research institutions and a large number of talents training, there are phenomena such as brain drain, shortage of high-end talents, and mismatch between talent structure and industrial demand, which makes it difficult to meet the diversified demand for talents in industrial innovation and development. To sum up, how to solve these problems, achieve the deep integration of innovation chain, industrial chain, capital chain and talent chain in Xi'an, and promote high-quality economic development is an important topic that needs in-depth research and exploration at present.

2. Literature Review

Shifting from high-speed growth to high-quality development is the distinctive feature and inevitable requirement of China's economic development in the new era. In the report, it is proposed to promote the deep integration of the innovation chain industrial chain capital chain talent chain (referred to as the "four chains"). Industry is the carrier of economic development, innovation is the first driving force leading development, capital and talent as two key support, the deep integration of the "four chains" is not only an important measure to build a new development pattern, but also an important support for building a modern system. Therefore, how to deeply integrate the "four chains" has become an important problem to be solved urgently. In summary, it is urgent to study the path and mechanism of the "four-chain" deep integration drive. After literature review, it is found that the research related to "multi-chain" integration mainly focuses on two aspects: realization path and guarantee mechanism:

(1) The path of "multi-chain" integration is mainly studied from the perspective of "double chain" integration and capital chain guarantee. 1) Representative views based on the "double chain" fusion perspective are: Enterprises in developing countries should follow the model of "industrial development driving technological progress", achieve technology accumulation through following innovation and integrated innovation in the initial stage of industry (Yang Shuili, 2020), and achieve industrial upgrading matching new industries and new technologies through independent innovation in the stage of industrial development, so as to achieve effective integration of industrial chain and innovation chain. Enhance the core capability of industrial autonomy (Guo Baitao et al., 2023). Enterprises can introduce or develop digital core technologies in industrial development to form the integration of industrial chain and digital technology innovation under the development trend of digital economy (Hong Yinxing and Ren Baoping, 2023; Nie Changhong et al., 2024). (2) The representative views based on the perspective of capital chain guarantee are as follows: enterprises should effectively apply the corresponding technical funds such as financing and subsidies to the research and development, industrialization and commercialization activities of technological innovation, so as to provide "resources and food" for the promotion of innovation chain and the integrated development of industrial chain and innovation chain (Li Xiaofeng, 2018; LAN Dingxiang and Bai Peiyu, 2023), thus achieving "three-chain" integration.

(2) The mechanism of "multi-chain" integration is mainly studied from the perspective of institutional environment and finance, taxation and finance. 1) Representative views based on the perspective of institutional environment include: the government should formulate corresponding norms and support policies for industrial development, build an open innovation platform, and clarify the core technological links of industrial development, so as to promote the guiding role of "government" in the integration of industrial chain and innovation chain (Yang Shuihui, 2020; Sun Qin et al., 2023). 2) Representative views based on the perspective of finance, taxation and finance are: The government should actively introduce and improve fund subsidy policies such as natural science fund and major science and technology special fund, encourage financial institutions to provide indirect financing opportunities for technological innovation activities of enterprises, and

strengthen direct financing functions such as venture capital in the capital market, so as to promote the integrated development of capital chain, industrial chain and innovation chain (Yang Zhong et al., 2023; Zhang Tingting et al., 2023).

To sum up, the existing research has made some achievements, but there are also limitations: first, there are abundant researches on the path of "multi-chain" integration from a single perspective such as "double chain" integration and capital chain guarantee, while the research results supported by "talent chain" are scarce; Second, there are more studies on the "multi-chain" integration of industries, innovation regulation policies and financial support mechanisms, while the research results based on market-led, innovation-driven, platform support and policy guarantee are still lacking.

3. There are Problems in Xi'an's Development from the Perspective of "Four-Chain" Integration

"Four-chain" integration is closely related to many factors, and it needs to resolve the contradiction between supply and demand. The research group's investigation of relevant experts and scholars found that China's "four-chain" integration faces the following five problems:

3.1. There are Shortcomings in Policy Coordination and Consistency

Many policies and institutions have been formulated, but there are still problems. There is a lack of institutions in some key areas, such as the lack of standardized guidance policies for the application and transformation of cutting-edge technologies in some emerging science and technology industrial parks. Policy constraints, such as Xi'an High-tech zone tax incentives and financial loan policies are not well coordinated. The integration layout of a series of systems is weak, such as the implementation standards of tax policies in different districts and counties are not uniform, and the approval process of special loans in the financial field is complex.

3.2. The Supporting Role of Science and Technology Intermediaries Needs to be Strengthened

First, the construction of achievement transformation platforms needs to be strengthened, and there is a serious problem of homogenization. Most of them only have the function of basic information display and lack the function of project docking and negotiation, which makes it difficult for scientific and technological achievements to connect with market demand. Second, Small and medium-sized enterprises have insufficient support for innovation resources, lack of their own key factors, weak construction of public science and technology intermediaries, and many achievements are difficult to translate and land. Third, the pricing mechanism of science and technology intermediaries is not perfect, resulting in low willingness of supply and demand parties to pay intermediary fees, which limits the survival and development of intermediary institutions. Fourth, the large gap of transformation talents and the lack of interdisciplinary talents restrict the development of intermediary agencies and the transformation of achievements.

3.3. Lack of Implementation Rules for the Transformation of Scientific and Technological Achievements at Different Levels

Although the relevant laws and regulations have provisions in principle, the specific rules are lacking. For example, most scientific research institutes and universities in Xi’an have unclear implementation processes for the transformation of achievements, poor links, no clear guiding terms for the distribution of transformation responsibilities and rights, and insufficient incentive and

guarantee measures, resulting in "no evidence to rely on", and researchers and managers "dare not" and "do not want to".

3.4. The Cohesion of Talents in Some Fields or Key Technical Links is Insufficient, and the Mechanism of Talent Training, Evaluation and Use Needs to be Improved

The total number of scientific and technological talents in China has advantages, but the structural contradictions are prominent, and the demand for innovation chain and industrial chain is disconnected, and the construction of disciplines and specialties cannot meet the demand. The application orientation of discipline setting in Xi'an universities needs to be strengthened, the initiative of enterprises to participate in talent training is limited, and there are bad academic ecological phenomena, which restricts talent development and the integration of "four chains".

3.5. The Problem of Back-end Financing in the Innovation Chain Needs to be Improved

The back end of the innovation chain is the key link of multi-agent collaboration to promote the transformation of technology value. Taking Xi’an as an example, there is a large capital gap in the industrialization of enterprises in the fields of biomedicine. Due to the weak evaluation of the commercial value of scientific and technological achievements, few professional evaluation and verification institutions, and the shortage of compound talents, financing difficulties restrict the industrial development and the transformation of innovative achievements.

4. The Realization of the Deep Integration of Xi'an's "Four Chains"

4.1. Build a High-quality Industrial Chain and Deploy an Innovation Chain around the Industrial Chain

Aiming at the forefront of global industrial innovation, based on China's scale advantages, supporting advantages and first-mover advantages shown in some fields in the industry, we will gradually and pertinently improve the self-sufficiency rate of upstream R & D and design links, and comprehensively improve the "original creativity" of technology and the "transformation" of results. The government should actively accelerate the pace of building an emerging industrial chain, vigorously promote the Internet, big data, artificial intelligence and other cutting-edge technologies to achieve deep integration with various industries, and effectively guide innovation resources toward the upstream and downstream enterprises in the industrial chain. We should take enterprises as the main body, carefully build a number of R & D institutions with key roles such as enterprise key laboratories, engineering centers, and enterprise technology centers around the upstream and downstream industry chains. For example, in the automobile manufacturing industry chain, the upstream automotive research and development design link has improved its independent research and development ability and reduced its dependence on foreign technology by increasing investment and introducing high-end talents. In the electronic information industry chain, the establishment of enterprise key laboratories has promoted breakthroughs in chip manufacturing technology and provided strong support for industrial development.

4.2. Build a High-level Innovation Chain, and Layout the Industrial Chain around the Innovation Chain

We want to always adhere to the comprehensive enhancement of independent innovation ability as a clear goal orientation, the enterprise's scientific and technological innovation and achievement

transformation should be accurately targeted at the national strategic needs and the actual needs of the market, highly focused on the key areas and core technologies of the industry, with special attention to strategic emerging industries and future industries, and then form a series of original and leading key technologies. By significantly improving the science and technology supply level of the innovation chain, it will effectively promote the transformation and upgrading of traditional industries, the fission development of emerging industries, and the forward-looking layout of future industries. For example, in the field of biomedicine, breakthroughs in the innovation chain have enabled traditional pharmaceutical companies to transform and produce high value-added biologics, emerging gene editing technology companies have been able to rise rapidly, and for future industries such as cell therapy, technical reserves and industrial planning have been made in advance.

4.3. Build a Highly Enriched Capital Chain and Promote the Deep Integration of the Innovation Chain and the Capital Chain

Scientific and reasonable capital chain layout around all links of the industrial chain and innovation chain, and further increase the investment in scientific and technological innovation, not only to increase the government financial investment in industrial basic research, but also to actively build a diversified investment and financing system platform that can cover all links of the "four chains". We will make the allocation of funds in the innovation chain more flexible, precise and effective. For example, in the new energy industry, the government's financial funds support the basic research of battery technology, while social capital provides sufficient financial guarantee for the production and promotion of new energy vehicles through investment and financing platforms.

4.4. Build a High-level Talent Chain to Provide Talent Support for the Industrial Chain Innovation Chain

Enterprises should carefully layout the talent chain around the industrial chain, relying on the talent chain to give strong energy to the industrial chain. Relevant enterprises should actively encourage and guide scientific and technological talents to gather in the front line of the industry, vigorously promote the mutual promotion and deep integration of the talent chain and the industrial chain, and form an excellent situation of "gathering talents by production, generating production by talent, and integrating talent into each other", and ultimately achieve the same frequency resonance of industrial development and talent gathering. The state should encourage enterprises to focus on the development of urgently needed key core technologies and talents in short supply, implement major research and talent projects, promote more "four-chain" integration tasks proposed by enterprises, and significantly improve the participation and discourse power of enterprises in the establishment, organization and implementation of science and technology projects and talent projects. For example, in the intelligent manufacturing industry, enterprises have trained a group of compound talents who understand both technology and management through cooperation with universities, providing a strong talent guarantee for industrial upgrading.

5. Conclusions and Suggestions

5.1. Research Conclusions

This paper finds that industrial chain, innovation chain, capital chain and service chain are important contents of innovation ecosystem, and they have the characteristics of element consistency and development compatibility. Deepening the integration of the "four chains" is an

effective way to improve the energy level of the innovation ecosystem. It is thanks to the development of the "four chains" and the mutual integration and interaction between the "four chains" that promote the expansion of the industry and the improvement of the energy level of the innovation ecosystem. Fundamentally speaking, the essence of "four-chain" integration is the process of cooperation and synergy deepening among different innovation entities such as enterprises, universities, research institutes, intermediaries, service institutions, innovation alliances, venture capital institutions, and financial institutions. Through the analysis of the framework model construction, the characteristics and laws of "four chains" integration are found: (1) The industrial chain is in the leading position in the "four chains", playing a leading and dominant role; (2) The innovation chain is in the middle of the "four chains" connection, is a key link in the scientific and technological innovation ecosystem, and is the fundamental driving force to promote the development and growth of the industrial chain; (3) The service chain is the "adhesive" between the innovation chain, industrial chain and capital chain, cooperation and complementarity is the essence of its construction, service systemization is its construction orientation, and industry and cross-industry service alliances and associations are its connecting hubs; (4) Innovation carrier agglomeration areas such as industrial cluster, innovation cluster, industrial base, science and technology park are the necessary space for the deep integration of "four chains"; (5) Industry-university-research cooperation organizations, large platforms for industrial R&D transformation (including industrial research institutes, advanced technology research institutes, industrial research institutes, etc.), innovation alliances, and large enterprises are key nodes for the deep integration of innovation chains and industrial chains; Enterprises are the main body of technological innovation, and the ability and number of innovation subjects in the region directly determine the success or failure of the "four-chain" integration.

5.2. Policy Suggestions

Based on the analysis of fusion model and fusion law, and from the perspective of strengthening the "four-chain" integration, this paper puts forward theoretical path suggestions for the energy level improvement of scientific and technological innovation ecosystem:

(1) The government should promote the integration of innovation chain and industrial chain, focusing on the identification of the core, key and common technologies of the upstream and downstream industries, sorting out a number of key technologies and common technologies urgently needed for industrial development, and forming a technological innovation chain; Guide innovation resources to gather in the upstream and downstream enterprises of the industrial chain, build a number of enterprise key laboratories, engineering centers, enterprise technology centers and other scientific and technological research and development institutions around the upstream and downstream industrial chain with enterprises as the main body, and promote the chain development of R & D institutions; Top companies should around the industrial chain with associations, alliances and other industrial organizations as links, integrate all kinds of research and development institutions, research and development platforms, and promote all kinds of research and development institutions to network connection.

(2) To promote the integration of innovation chain and service chain, the focus should be on the transformation process of scientific and technological innovation ability (innovation chain) to industrial innovation ability (industrial chain), to promote the close integration of innovation chain and industrial chain, accelerate technology diffusion and transfer, and promote the effective connection of research and development and transformation for the purpose of aiming at all aspects of research and development, transformation and industrialization from technology to product to market. We will systematically promote the establishment of various science and technology service

institutions such as technology transfer, achievement transformation, intellectual property rights, science and technology intermediaries, industrial design, inspection and testing, and market development, and build a systematic and all-round science and technology service chain.

(3) To promote the integration of innovation chain and capital chain, the focus should be on maximizing the use of funds as the goal, focusing on innovation subjects and innovative technologies at different stages of the innovation chain, rationally layout innovation funds, and build a scientific and reasonable financial support chain: The first is to build a financial support chain for innovation platform construction around the innovation institutions connected upstream and downstream of the industrial chain (vertical innovation chain); Second, around the innovation institutions in different links of the innovation chain, support their key product development (horizontal innovation chain), forming a project research and development fund support chain from technology research and development to product industrialization; At the same time, it is necessary to actively mobilize social venture capital, focus on the layout of the capital chain, and build a number of scientific and technological financial service platforms with strong service capabilities.

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