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New Paradigm of University Scientific Research in the New Era: The Connotation, Carrier, and Implementation Path of Organized Scientific Research

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Abstract:
With the accelerated evolution of a new round of scientific and technological revolution and industrial revolution, modern scientific research activities have shown new characteristics such as deep interdisciplinary, application-oriented, and highly organized. As the main force of scientific research, the source of innovation drive, and the main battlefield of talent cultivation, universities must place the improvement of scientific research and innovation capabilities in a more prominent position, focus on the major strategic needs of the country and the needs of regional economic and social development, transform the research paradigm, and deeply promote "organized scientific research" to effectively undertake the responsibility and mission of serving the high-quality development strategy with high-level scientific research and innovation.

Keywords: New Era, University Scientific Research, New Paradigm, Organized Scientific Research

I. Introduction

With the accelerated evolution of the new round of technological revolution and industrial revolution, modern scientific research activities exhibit new characteristics such as deep interdisciplinarity, application-oriented directionality, and high organization. To adapt to this new situation, the government is actively promoting the transformation of management and service functions, continuously strengthening direction guidance, layout coordination, and designated funding for scientific research. This has gradually evolved into a new model of "organized scientific research," characterized by unified organization and centralized investment by the government, with researchers targeting major national needs and implementing guided, directed scientific innovation practices[1]. Currently, the new round of technological revolution and industrial transformation is advancing rapidly, and the scientific research paradigm is undergoing profound changes. Interdisciplinary integration continues to develop, and the integration of science and technology with economic and social development is accelerating.

Universities, as the main force of scientific research, the source of innovation-driven initiatives, and the main base for talent cultivation, possess a complete disciplinary system, a large research team, and numerous research platforms. They have already become an important force in the development of national scientific research undertakings. In the current context of competition in technological strength and innovation capabilities, universities, as an important organizational component of the national

innovation system, must place enhancing scientific research and innovation capabilities in a more prominent position. They should focus on major national strategic needs and regional economic and social development needs, transform the research paradigm, and deeply promote "organized scientific research" to truly shoulder the responsibility and mission of serving high-quality development strategies through high-level scientific research and innovation.

II. The Era Background of the Paradigm Shift in University Scientific Research in the New Era

The paradigm of university scientific research has undergone profound changes in the new era. The university research environment has shifted from unorganized and free research to organized research. The concept of "organized research" reflects the new situation faced by technological innovation and signifies a profound transformation in the research organization model. From a broader perspective, the emergence of organized research is due to two main reasons. Firstly, the current international situation is experiencing drastic changes, and the survival environment for technological development has deteriorated, leading to insufficient knowledge supply. The original multi-channel paths for obtaining knowledge have gradually evolved into a self-sufficient single-channel mode, necessitating a change in the original knowledge production model. Secondly, the loose and free-form research model can no longer meet society's urgent demand for knowledge (similar to the transition from small workshops to machine-based large industries during the early stages of the first industrial revolution). A new nationwide system must be adopted to increase the supply of scientific and technological knowledge, which must operate through organization and institutionalization to achieve the goal of high-level scientific and technological self-reliance and strength.

2.1 National Strategic Development Requires "Organized Research"

Accelerating the implementation of an innovation-driven development strategy, guided by national strategic needs, and gathering strength for original technological breakthroughs is essential[2]. Strengthening basic research, emphasizing originality, and encouraging free exploration are crucial. Organized research aims to better leverage the advantages and characteristics of free exploration, focusing on national strategic needs to organize scientific research, talent cultivation, and innovation hub construction, thus promoting higher-quality scientific and technological innovation in universities[3]. For the country, this reflects the adjustments in science and education policies on the research governance models of universities, guiding them through system and mechanism innovation to gather strength for original, leading-edge, key technological breakthroughs. For universities, organized research involves proactively planning research production, organizing research teams for collective collaboration, and innovating resource investment and management systems to address significant external research needs[4]. Organized research is an important form for universities to institutionalize and systematically serve national and regional strategic needs and socio-economic development[5]. Currently, universities are actively promoting organized research as an important aspect of fulfilling their scientific research and social service functions and advancing their development. Universities should proactively recognize changes, actively respond to them, deeply understand the rich connotations of organized research under the new nationwide system, strive to grasp the current paradigm shift in research, actively respond to major national strategic needs, and effectively fulfill the national strategic development requirements of building a strong education, science, and talent country. This will provide the necessary research support for the in-depth implementation of the strategies of invigorating the country through science and education, strengthening the nation with talents, and driving innovation, opening up new fields and tracks for development, and continuously shaping new driving forces and advantages for development.

For universities, high-level research universities are important strategic scientific and technological forces for the country, bearing the responsibility of talent cultivation. During the nurturing and validation phases of strategic scientific and technological forces, they can promote the collision of ideas from different disciplines and the emergence of principle prototypes. Academician Yang Wei stated that the new pattern of science and education development lies in the triple helix of education, science, and talent. In recent years, relying on the triple helix model, a batch of representative scientific and technological achievements has emerged. Academician Yang Wei vividly demonstrated to teachers and students forward-looking basic research cases such as neutrino oscillations, supergravity problems, photon entanglement, and quantum communication, including innovative exploration practices at Zhejiang University, such as key technologies for earth pressure balance shield machines and soft robots challenging the Mariana Trench.

2.2 The Path of Independent Innovation Requires Organized Research

Since the reform and opening-up, China's economy has experienced different development-driven models, which can be divided into four stages. The initial stage of reform and opening-up was characterized by efficiency-driven innovation represented by Chinese manufacturing and block economies, rapidly occupying the market with low-cost production to gain the largest market share. The second stage was development-driven innovation, internalizing advanced technology through introduction for its own use, representing an integrated innovation model. The third stage was high-tech-driven innovation, relying on existing scientific knowledge to break through core technologies, mastering "bottleneck" technologies, and obtaining intellectual property, represented by nuclear technology. The fourth stage, which is the current development model, is disruptive innovation, creating new results and developing new products based on basic research, thereby achieving an overwhelming monopoly position in the market. This requires two major elements: the integration of the innovation chain, industrial chain, capital chain, and talent chain, and the upward movement of the triple helix of education, science, and talent. Universities are important strategic scientific and technological forces for the country, bearing the responsibility of talent cultivation. During the nurturing and validation phases of strategic scientific and technological forces, they can promote the collision of ideas from different disciplines and the emergence of principle prototypes. The new pattern of science and education development lies in the triple helix of education, science, and talent. In recent years, relying on the triple helix model, a batch of innovative scientific and technological achievements has emerged, such as neutrino oscillations, supergravity problems, photon entanglement, and quantum communication. Innovative exploration practices at Zhejiang University, such as key technologies for earth pressure balance shield machines and soft robots challenging the Mariana Trench, reflect the profound impact of organized research on China's independent innovation.

2.3 High-Quality Basic Research Requires Organized Research

Basic research is the source of the entire scientific system and the general mechanism for all technical problems. Continuously strengthening basic research is an urgent requirement for achieving high-level scientific and technological self-reliance and strength and is the only way to build a world-class scientific and technological power. Universities should consciously fulfill the mission of high-level scientific and technological self-reliance and strength, seize the opportunities of the new round of scientific and technological revolution and industrial transformation, strengthen organized promotion of basic research, establish long-term stable support mechanisms, actively explore diversified basic research investments, build a good innovation ecosystem, and accelerate major breakthroughs in original results. "Organized basic research" can bridge the gap from science to technology to industry, promoting the organizational vitality of innovation. The driving effect of technology on industry, economy, and society is becoming increasingly prominent, and the demand for technological innovation and industrial development is also

becoming the source and driving force of basic research problems. The integration of the innovation chain and the industrial chain is accelerating, and innovative activities now require the joint participation of the government, universities, research institutions, and enterprises to solve the full-chain problems of basic research, technical science, and industrial applications. In the new trend of interdisciplinary, integrated science, and technological innovation development, basic research needs to strengthen its organizational nature, organizing different innovation entities, enabling academic research to transcend traditional disciplinary boundaries, breaking down traditional barriers between academia, industry, and other sectors, and promoting the flow of information between individuals and organizations. In this sense, "organized basic research" can comprehensively promote organized innovation[6].

III. The Connotation and Carriers of Organized Scientific Research in Universities

3.1 The Connotation of Organized Scientific Research in Universities

Organized scientific research in universities refers to universities integrating their strengths proactively, systematically, and in an organized manner to conduct collaborative research with the aim of serving national needs. Essentially, organized scientific research is a research paradigm that focuses on integrating and coordinating efforts to better serve national needs. It takes advantage of the new national system, focuses more on national strategic needs, and enables the organic integration of various innovation elements, promoting a more rational allocation of scientific and technological forces and innovation resources. At the same time, organized scientific research fosters the exchange and collision of diverse knowledge and different ways of thinking through the convergence of talents from different disciplines, promoting the emergence of new viewpoints, methods, theories, and ideas. The organized scientific research in universities has shown multiple evolutions in four aspects: research goals, research organization, research subjects, and research content. The research goals are shifting from "generalized and loose" to "problem-focused." In the past, university research activities followed a free exploration model based on academic logic and disciplinary paradigms, with relatively generalized and loose research goals. On one hand, aiming to promote knowledge innovation in corresponding academic fields, research activities were primarily conducted within the context of single disciplines, with little involvement from other disciplines. On the other hand, due to a high dependency on resources, university research also needed to serve specific research needs from the market and enterprises. Research organization is moving from "tangible organizationality" to "organized beyond tangibility." Previously, university research activities were mainly carried out by grassroots disciplinary and departmental organizations, with research personnel, research projects, research resources, and research management work all relying on departmental organizational entities. Compared to the previous mode of "tangible organizationality," organized research strives to transcend the boundary limitations of organizational entities by adjusting organizational forms and reforming models, exploring the establishment of a more flexible and responsive "academic community" oriented towards research tasks. Research subjects are transitioning from "single-party dominance" to "multi-party collaboration." Previously, research and innovation activities mainly took place within the university domain, with university teachers, researchers, and graduate students being the main participants. Universities played a leading role in initiating, organizing, and implementing research activities. Organized university research, on the basis of seeking multi-party investment, further emphasizes the deep participation and collaborative cooperation of multiple subjects. Relevant government departments, interested enterprises, and third-party social institutions actively participate and collaborate across boundaries in multiple stages such as research topic selection, specific conduct, and result transformation. Research content is shifting from "single-field" to "multi-dimensional." Previously,

some university research activities were initiated more by scholars' interests or the requirements of commissioning parties, conducting research within single disciplines, single technologies, or single practical scenarios, with little involvement in cross-disciplinary, multi-technology, or multi-practical scenario explorations. Organized university research advocates cross-field intersections, horizontal interactions, and deep integration, making research content more multidimensional. Its connotation is mainly reflected in: firstly, organized scientific research embodies a demand-oriented approach, seeking to proactively serve major national strategic needs. Universities must shift from researching what they can to researching what the country needs, moving from a "passive acceptance" and "blind following" approach to proactive planning, proactive layout, and proactive service. Secondly, organized scientific research reflects a problem-oriented approach, taking the initiative in solving critical and core technological bottlenecks. Problems are the driving force of innovation. Comprehensive universities, in particular, must utilize the "catalyst" of interdisciplinary integration to break the traditional research model dominated by disciplines, integrating multidisciplinary strengths to form cross-disciplinary research teams and effectively enhance the collaborative effort in tackling key core technologies. Thirdly, organized scientific research embodies a talent cultivation-oriented approach, gaining the initiative in improving the quality of talent cultivation. Universities need to not only focus on enhancing scientific and technological innovation capabilities but also seize the key point of improving talent cultivation quality, continuously improving the system of scientific research-based education, and transforming the advantages of scientific research into advantages in talent cultivation. They should fully utilize the university's research platform resources to build a group of leading scientific talents and high-level innovative teams[7].

3.2 The Carriers of Organized Scientific Research in Universities

Establishing multiple pathways for organized scientific research carriers. Similar to discipline-oriented research relying on departmental organizations, organized scientific research in universities also requires corresponding carriers for support. Firstly, universities can develop organized scientific research institutions through an incubation pathway. Flexibility is one of the important characteristics of organized scientific research in universities; therefore, organized scientific research institutions should also reflect flexibility. In the early stages of developing organized scientific research carriers, universities can establish non-physical organized scientific research carriers through special plans or projects, forming virtual interdisciplinary research teams around external research tasks or specific research goals. Once these non-physical organized scientific research teams mature, they can be transformed into physical organized scientific research institutions, following an incubation pathway from non-physical to physical organized scientific research institutions. This incubation development pathway can effectively ensure that organized scientific research institutions can be flexibly added, expanded, or terminated based on actual needs. Secondly, universities can develop organized scientific research institutions through a derivative pathway. For physical organized scientific research institutions, universities can prioritize the creation of independently established organized scientific research institutions that are completely independent of departments and parallel to traditional colleges. This ensures that organized scientific research is not constrained by the traditional departmental organizational structure, allowing it to flexibly transcend disciplinary boundaries to conduct organized research on major strategic, frontier, and urgent real-world issues. Once independently established organized scientific research institutions reach a certain scale, other forms of organized scientific research institutions can be created, such as establishing cross-university organized scientific research institutions conducted by multiple universities in collaboration, following a derivative development pathway from single-form to multi-form organized scientific research institutions[8]. Currently, the organized scientific research carried out by universities mainly relies on

government platform construction plans, building major scientific research platforms. These platforms can rapidly gather talent and resources. Chinese universities generally leverage government policies on scientific research platform construction, establishing a pyramid-like structure of scientific research platforms from "College-School-Province-Ministry-Nation" within the campus. Through upgrading platform levels, they continuously aggregate internal and external scientific research resources, enhance their capacity for scientific research breakthroughs, and undertake major scientific research projects with the highest-level platforms. For clusters of advantageous disciplines, special scientific research zones are set up within the campus, establishing dedicated research institutions to conduct comprehensive research in advantageous fields over the long term, thereby creating the school's core technological competitiveness. Taking external funding as an opportunity, independent new research institutions are established; some industry-leading enterprises or government departments often rely on high-level research universities to establish corresponding research institutions to promote research in specific fields. Facing future frontier technologies, interdisciplinary research centers are established. Due to the significant role of interdisciplinary integration in major scientific discoveries and complex problem-solving, interdisciplinary research is increasingly becoming a highly regarded organizational model for scientific research and technological innovation in today's world. Establishing interdisciplinary research centers for future frontier technologies is an important model for universities to conduct organized scientific research.

IV. Implementation Pathways for Organized Scientific Research in Universities

National laboratories, national research institutions, high-level research universities, and leading technological enterprises are essential components of the national strategic scientific and technological force. They must consciously fulfill the mission of high-level scientific and technological self-reliance and self-improvement. "Organized scientific research" requires universities to closely align with the country's major strategic needs, organizing scientific and technological innovation activities through a systematic and institutionalized model. Universities should proactively undertake the research and development tasks of major national scientific and technological projects, strengthen the construction of national strategic scientific and technological forces, and achieve significant breakthroughs in areas such as goal-oriented basic research, key core technologies urgently needed by national strategies, and the transfer and transformation of scientific and technological achievements. This process often necessitates that universities collaborate with external organizations such as the government, enterprises, and research institutions, focusing on solving practical problems to form long-term stable cooperative relationships, jointly carrying out scientific research and technological achievement transformation. Simultaneously, to form cross-departmental and interdisciplinary research teams and promote the organic integration of external functions like industry-academia-research cooperation with the university's primary work, universities also need to undergo internal organizational reform and improve their systems. This includes managing and operating national laboratories, establishing interdisciplinary research centers and technology transfer offices, and enhancing mechanisms for evaluating scientific research achievements. The advantage of "organized scientific research" lies in building large platforms by concentrating resources in the fields of major scientific issues, engineering technology challenges, and industrial technology problems, forming research clusters that sustain long-term efforts. Universities can leverage the significant opportunities provided by deeply participating in national strategic scientific and technological projects to enhance their scientific research levels and academic reputation, fostering a win-win cycle of cooperation. In this new development stage, Chinese universities should, on the basis of continuously conducting high-level free exploratory research, aim to better serve the real issues and urgent

needs faced by national security and economic and social development. They should accelerate the transformation of research paradigms and organizational models, further strengthening organized scientific research.

Firstly, deepen the reform of the scientific research system and mechanisms in universities to encourage organized scientific research. Construct an organizational framework that adapts to organized basic research. Optimize the governance structure of universities to support organized basic research, explore the organizational restructuring and functional optimization of scientific research management. Strengthen the construction of scientific research management teams, enhance the professional level of scientific research management personnel, break down collaborative barriers in scientific research management departments, and improve the management efficiency of organized scientific research projects. Construct an evaluation system that conforms to the laws of basic research and talent growth. Improve the evaluation system that adapts to organized basic research, and accelerate the establishment of a scientific research performance evaluation system oriented towards the quality of innovative achievements and actual contributions, paying attention to the actual contributions of interdisciplinary cooperation results.

Secondly, reform the scientific research organizational model and strengthen organized scientific research. Universities should, based on the characteristics of the industrial structure and the research and development needs of key technological fields at different stages of national economic and social development, formulate overall development goals and special plans for scientific and technological innovation. They should choose the main research directions for organized scientific research based on their disciplinary advantages, and strengthen collaborative innovation and cooperation with national laboratories, new research institutions, and leading technological enterprises, proactively building multidisciplinary research teams.

Thirdly, improve the setup of research institutions to promote organized scientific research. Universities need to establish specialized industry-university-research management cooperation institutions with a certain degree of decision-making autonomy and market judgment under the guidance of school development plans and educational philosophies. Based on disciplinary advantages and the key industrial layout of their regions, they should actively participate in the construction of national technology innovation centers, gather high-quality scientific research resources, provide high-quality source technology supply for industry enterprises, and enhance the innovation capability and core competitiveness of key industrial fields in China[9].

Fourthly, strengthen the cultural atmosphere of scientific research and form an open innovation ecosystem. Organized scientific research in universities should rely on the long-term layout and continuous advancement of scientific and technological talents and innovation resources, fostering an atmosphere of academic exploration that seeks common ground while reserving differences, a mutually beneficial and win-win scientific research cooperation style, and a locally distinctive shared innovation culture, forming an open innovation ecosystem. On one hand, in the face of major issues and significant needs, organized scientific research in universities must break down the barriers and prejudices between different academic exploration activities, cut off the chain of contempt in research fields, academic paradigms, and research methods, and establish a more equal and free academic concept and cognition, creating a pure, free, inclusive, and open interactive academic atmosphere for heterogeneous academic exploration and scientific and technological innovation. On the other hand, organized scientific research in universities needs to leverage the academic attractiveness of major issues, the value mobilization power of significant needs, and the collective appeal of common goals, actively mobilizing and convening scientific research talents from different fields, types, and sectors, based on the consensus points of interest in knowledge

creation, academic exploration, and technological innovation. It should integrate theoretical knowledge and logical thinking from different disciplines, practical experience from different fields, and methodological frameworks from different research paradigms, seeking effective solutions for theoretical innovation and practical exploration in the advancement of academic research and the resolution of academic problems.

V. Conclusion

For university scientific research, the "Four Services" should become the mission and responsibility of all university scientific research. Universities should take "serving the major strategic needs of the country and regions, and the major needs of economic and social development as the main direction of technological innovation." Under the inspiration of the service mission, universities should not only apply the results of free exploratory research to society but also organize scientific research purposefully and directionally according to the directions needed by national strategies and economic and social development. They should transform the traditional scientific research paradigms and organizational paradigms in ways conducive to producing results that meet national and social needs, thereby constructing new forms of organized scientific research that facilitate the fulfillment of the service mission.

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