



Study on Strengthening the Path of Organized Scientific Research in Universities in Shandong Province

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Abstract. Universities are important carriers of scientific and technological innovation, and organized scientific research is an important development trend of university scientific research. This study combs through the current situation of the development of organized scientific research in Shandong universities and the existing problems, combines the essential characteristics of organized scientific research, and puts forward high-quality development suggestions from three perspectives, namely, basic R&D investment, transformation of scientific and technological achievements, and integration of innovative resources.

Keywords: Organized scientific research; Shandong province, High-quality development suggestions.

1 Introduction

At present, organized scientific research has become the main form of scientific research activities in universities in various countries. For example, universities in the United States have launched the "Grand Challenges" programme in response to major social problems^[1]. China has issued a policy entitled "Opinions on Strengthening Organized Scientific Research in Universities and Promoting High-Level Self-Reliance and Self-Strengthening", which emphasizes that organized scientific research is an important form of service for universities in the context of national strategies. As a result of this policy, many Chinese universities, such as Shandong University, have carried out institutional reforms to promote the effective implementation of organized scientific research, and have achieved remarkable results.

Studies related to organized scientific research date back as far as the 1990s, with initial explorations of its content and form^{[2][3]}. For example, Geiger notes that organized research units are interdepartmental and interdisciplinary research units at

universities that have externally funded missions as their primary goal^[2]. In recent years, as the competition in science and technology has become more and more intense, there has been a gradual increase in the number of related researches on the formation elements^[4], impact effects^{[5][6]}, organization mode^[7], and countermeasure suggestions^[8] of organized scientific research in universities. In summary, most of the existing studies of organized scientific research are from a macro perspective, and few studies focus on micro studies in a single region.

Shandong, as a major education province in China, urgently needs to enhance the overall scientific and technological innovation capacity by changing the organizational model of university research. In this context, this paper proposes useful opinions for the high-quality development of organized scientific research in universities in Shandong Province through an in-depth study of the status quo and problems of the development of organized scientific research in universities in Shandong Province. This paper will promote the development of organized scientific research in universities in Shandong Province in the direction of higher quality, efficiency and sustainability.

2 Current Status of Organized Scientific Research Development in Universities in Shandong Province

2.1 Comprehensive Innovation Strength Significantly Improved

First, the scientific research team of universities continues to grow. At present, nearly 150,000 people are engaged in scientific research in universities in Shandong Province, and there are 1,830 national leading talents. Second, the scientific research and innovation platform of colleges and universities is developing vigorously. Shandong Province has recognized more than 340 university laboratories, key laboratories, specialty laboratories and liberal arts laboratories, and the proportion of provincial key laboratories built on the basis of universities has reached 45%. Third, the ability to undertake major scientific research tasks has been significantly enhanced. Shandong universities actively undertake scientific research projects. For example, Shandong University has been approved 12 national major projects in 2023 and 45 annual projects of the National Social Science Foundation (ranked eighth in the country).

2.2 Significantly Increased Capacity for Resource Integration

First, Shandong Province has implemented in-depth reforms in the integration of science and education, and has built a new mechanism for talent cultivation through the in-depth integration of "colleges, research institutes and industrial groups". Second, Shandong Province has signed strategic cooperation agreements with universities of the Chinese Academy of Sciences and other high-level scientific research institutes, and has promoted more than 20 universities to set up collaborative innovation teams with more than 60 scientific research institutes and industry-leading enterprises to jointly carry out scientific and technological research. Third, Shandong universities actively innovate new modes of scientific research organization. For example, Shandong

University has innovatively constructed a new model of "one professor, one enterprise" for the integration and development of universities and enterprises, in which the team of professors is directly facing the needs of enterprises, thus improving the efficiency of the transformation of scientific research results.

2.3 Continuous Optimization of Science and Technology Innovation Ecology

First, Shandong Province has comprehensively sorted out and improved the documents of university scientific research evaluation system, highlighting the evaluation of scientific spirit, quality of innovation and social contribution in the selection process of university scientific research and innovation platforms and talent teams and so on. Second, Shandong Province has issued relevant policies to guide universities to deepen the reform of scientific research funding and amplify the effectiveness of the use of scientific research funding. Third, Shandong Province has authorized universities to independently determine the internal distribution plan of performance pay, giving researchers the right to distribute greater benefits. At present, the proportion of incentive performance pay in the total performance pay of universities has exceeded 70%, effectively stimulating the enthusiasm of scientific researchers for scientific and technological innovation.

3 Problems in the Development of Organized Scientific Research at Universities in Shandong Province

3.1 Uneven Investment in R&D

First, Shandong province's university R&D investment is small compared with other provinces. For example, in 2022, R&D investment in universities in Guangdong Province and Jiangsu Province will be 2.09 and 1.77 times higher than that in Shandong Province, respectively. Second, the direction and structure of R&D investment in Shandong Province is unbalanced. For example, in 2022, the proportion of basic research, applied research and experimental development funding in Shandong Province will be 4.1%, 7.5% and 88.4% respectively. Thirdly, the R&D investment among regions is not balanced. In 2022, Jinan and Qingdao will invest more than 30 billion yuan in R&D, while Zaozhuang and Heze will invest less than 5 billion yuan in R&D, and there is a big gap in R&D investment among regions.

3.2 Inadequate Mechanisms for Transforming Results

First, the level of transformation of scientific and technological achievements in Shandong Province is not high. The data show that only three universities in Shandong Province are ranked among the top 50 in the country in terms of the amount of contracts for the transformation of scientific and technological achievements. Second, most of the universities in Shandong Province have not yet established scientific and technological achievements transformation service organizations, and the work is mainly carried out

by the administrative departments on behalf of them. Third, the scientific and technological innovation of universities in Shandong Province fails to start from the actual needs of the upstream and downstream of the industrial chain, which leads to the decoupling of scientific and technological achievements from the needs of the society and low transformation efficiency.

3.3 Industry-Academia-Research Integration is Still not Close Enough

First, due to the competition of interests between universities, Shandong Province has not yet established a service organization for the integration and sharing of university resources, which has led to the lack of close scientific research links between universities. Second, university-enterprise cooperation is weak. On the one hand, the mechanism of transforming scientific and technological achievements of universities to enterprises is not sound enough, and it is difficult to fully realize the commercialization value of the achievements. On the other hand, enterprises and universities and institutes have not yet formed a mechanism for sharing benefits and risks, which has weakened the effectiveness of cooperation between enterprises and universities.

4 Analysis of the Essential Characteristics of Organized Research in Universities

First, organized scientific research in universities is separated from the traditional departmental structure. Organized scientific research can cross the boundaries of the disciplinary organization of colleges and universities, effectively integrate internal and external resources, and carry out targeted scientific research tasks in a more flexible organizational form. Second, organized scientific research in universities is oriented to respond to external needs. Organized scientific research requires university researchers to carry out research on major scientific issues in an organized manner, and respond to the urgent needs of external stakeholders of universities in a timely and effective manner. Thirdly, organized scientific research in universities plays a moderating role between knowledge production and real needs. Organized scientific research in universities enables researchers to carry out task-oriented research that meets real needs according to their own academic interests.

5 Suggestions for High-Quality Development of Organized Scientific Research in Universities in Shandong Province

5.1 Increase Investment in Basic R&D

First, increase the government's financial investment in basic research, while guiding social forces to make direct donations or set up funds to support universities in carrying out basic research. Second, build a long-term and stable support mechanism for basic research to stimulate the innovation vitality of basic research talents and teams.

Optimize the design of scientific and technological evaluation and the treatment of scientific researchers, and enhance the sense of achievement of basic researchers. Thirdly, local universities should be encouraged to cooperate with industrial enterprises to build regional science and technology innovation platforms, strengthen cross-regional cooperation and innovation among universities, and promote the balanced development of R&D capacity among regions^[9].

5.2 Improvement of the Mechanism for the Transformation of Scientific and Technological Achievements

First, universities should take into account the interests of all parties involved in scientific and technological achievements, and formulate and improve the incentive mechanism for the transformation of scientific and technological achievements. Second, universities are guided and encouraged to establish scientific and technological achievements transformation service institution and promote the formation of market-oriented operation system. Third, universities should strengthen university-enterprise cooperation in light of the development needs of local industries, and enhance the docking of scientific research achievements with social needs^[10].

5.3 Strengthening the Integration of Innovative Resources

First, promote the cross-disciplinary integration of university disciplines. Universities are encouraged to arrange interdisciplinary research institutions at the university level around key areas, and to build an an orderly interdisciplinary development ecology. Second, promote the optimization and integration of scientific research platforms. Actively promote the optimization and reorganization of national and provincial research platforms such as national key laboratories in universities. Explore the construction of a multi-level organized scientific research platform system of "school level - provincial and ministerial level - cultivating national level - national level". Third, establish a resource sharing mechanism among universities. Establish an industry-university-research alliance among universities in the province, set up a special fund to support cooperative research among universities, encourage interdisciplinary and cross-field cooperation, and promote the optimal allocation of scientific research resources. Fourth, strengthen the exchange between enterprises and universities. Encourage enterprises to participate in the R&D activities of universities through the establishment of joint laboratories and joint R&D projects. Explore the promotion of diversified university-enterprise cooperation methods such as technology shareholding and equity incentives to enhance joint R&D capabilities.

6 Conclusions

This paper takes the current situation of the development of organized scientific research in universities in Shandong Province as an entry point, examines in detail the problems of the development of organized scientific research in universities, and puts

forward optimization suggestions in combination with the essential characteristics of organized scientific research. This paper aims to provide useful suggestions for the future development of organized scientific research in universities in Shandong Province and to provide references for other provinces. Some of the contents are not fully developed due to circumstances and resource limitations, and it is anticipated that future studies will conduct in-depth empirical studies.

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