

Essential Characteristics, Basic Logic and Implementation Path of the Transformation of Sports Science and Technology Achievements from the Perspective of Chinese Modernization

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Abstract: This paper examines the transformation of sports science and technology achievements within the strategic context of Chinese modernization. It argues that this process constitutes a strategically driven, systemic innovation practice distinct from conventional technology commercialization, characterized by the integration of strategic and people-centric objectives, the synergy between the "new type of nationwide system" and the Chinese special market economy, and the pursuit of composite strategic, economic, social, and cultural values. The analysis reveals a nested logic underpinning the transformation, involving target-driven orientation, a dual-engine of strategic demand and market mechanisms, networked and iterative processes, and a cyclical value-creation spiral. Accordingly, effective implementation requires a multi-level, differentiated strategy: optimizing top-level design and institutional foundations at the macro level; innovating market mechanisms and cultivating professional intermediaries at the meso level; and empowering diverse actors and leveraging scenario-driven models at the micro level. The success of this "Chinese paradigm" hinges on organically integrating an effective market with a proactive government while steadfastly adhering to a people-centered development philosophy.

Keywords: Sports Science and Technology Achievement Transformation; Chinese Modernization; Essential Characteristics; Basic Logic; Implementation Paths

1. Introduction

Chinese modernization, characterized by a huge population, common prosperity for all,

coordination between material and spiritual civilization, harmony between humanity and nature, and peaceful development, provides the fundamental strategic context and value basis for all contemporary endeavors in China [1]. Within this grand historical process, the development of sports has been endowed with unprecedented strategic missions such as building a "sports power," contributing to a "Healthy China," and serving "common prosperity." As the core engine driving the high-quality development of sports, the effectiveness of transforming sports science and technology achievements from laboratories and training grounds to the market and benefiting the public directly relates to the realization of these strategic goals [2]. Therefore, deeply analyzing the unique nature, internal logic, and feasible paths for the transformation of sports science and technology achievements in the process of Chinese modernization is not only an urgent practical issue but also an academic topic with profound theoretical significance. It transcends the traditional Western paradigm centered on market efficiency and technology transfer, presenting a "Chinese paradigm" profoundly shaped by national strategy, ultimately concerned with people's well-being, and characterized by systemic synergy as a methodological feature. This paper aims to systematically deconstruct this paradigm, reveal its essential characteristics, clarify its basic logic, and outline its implementation paths, in order to provide theoretical reference and practical insights for constructing a high-efficiency sports innovation ecosystem.

2. Essential Characteristics: A Strategically Driven Systemic Innovation Practice

Within the unique context of Chinese modernization, the transformation of sports science and technology achievements exhibits

essential characteristics distinct from general technological innovation activities [3]. It is by no means a simple process of technology commercialization but a complex social practice deeply embedded in the national governance system and development strategy, possessing clear political, social, and systemic attributes. The primary and most fundamental characteristic is the high degree of unity between its strategic nature and its people-centric nature. The purpose of transformation is not merely to create economic profit or win competitive honors; its deeper value lies in serving the development philosophy of "putting people at the center" and the overall layout of national modernization. This means that the value assessment criteria for a sports science and technology achievement are multiple and composite: it must be capable of enhancing the nation's competitive strength in major international events, shaping the national image, and strengthening national cohesion, while also being transformable into products and services that improve national health, promote the physical fitness of youth, and meet the diverse sports needs of the people. For example, the successful transformation of high-performance fabric materials developed for the Winter Olympics national team is not only reflected in helping athletes achieve excellent results but also in the technology's application to mass winter sports equipment and even daily outdoor products, enhancing the sports experience and safety of ordinary people. This requirement of "reaching for the heights while grounding in reality" ensures that transformation activities always position themselves within the dual coordinates of "national needs" and "people's expectations."

Secondly, this process profoundly embodies the organic combination and complementary advantages of the "new type of nationwide system" and the "Chinese special market economy." This constitutes the most significant institutional characteristic of sports science and technology achievement transformation in China. On the one hand, the "new type of nationwide system," driven by major strategic demands, can effectively integrate innovation resources across departments, fields, and regions to conduct organized scientific research and rapid application. In areas such as core technologies for competitive sports and technologies for major event support, this system can quickly concentrate the elite forces of universities,

research institutes, and enterprises to achieve breakthroughs and complete application transformation within a short period [4]. On the other hand, in broad market areas such as public fitness, sports consumption, and smart equipment, the decisive role of the market in resource allocation is fully leveraged, with enterprises leading the innovation direction based on market demand. The government's role here is more about creating a fair competitive environment, providing basic institutional supply, and creating initial markets through government procurement. This "dual-wheel drive" model enables transformation to both tackle "bottleneck" problems and stimulate the vitality of micro-entities.

Thirdly, transformation activities exhibit strong characteristics of system integration and ecological evolution. It is no longer simplistically understood as linear technology transfer but is regarded as a process of non-linear interaction and co-evolution occurring within a complex innovation ecosystem. This ecosystem consists of multiple types of actors—government, industry, academia, research, application, finance, and intermediaries—as nodes, linked by flows of knowledge, technology, talent, capital, data, and policy [5]. Successful transformation depends on high-frequency, efficient, and high-quality interaction and synergy among these nodes. For example, the transformation of a sports rehabilitation technology may require precise demand identification from clinical medical institutions, foundational theory from universities, applied development from research institutes, product engineering and market promotion by enterprises, financial support from venture capital, negotiation and connection assistance from technology transfer agencies, and ethical approval and industry regulation by government departments. The health of the entire ecosystem determines the smoothness of transformation channels and overall efficiency.

Finally, the value creation of transformation is distinctly comprehensive and public. Its pursuit is not singular economic return but the composite unity and synergistic enhancement of strategic value, economic value, social value, and cultural value. Strategic value concerns national interests and security; economic value manifests as industrial growth, corporate profits, and job creation; social value points to public health promotion, social inclusion, and fairness;

cultural value is associated with the promotion of sportsmanship and the leadership of sports lifestyles [6,7]. A successful transformation often achieves positive synergy across these four dimensions. For instance, the construction of smart community fitness centers, utilizing technological achievements like the Internet of Things and big data, may not only give rise to new service formats but also directly promote residents' active participation in exercise, enhance community vitality and governance levels, and potentially integrate local sports cultural characteristics, ultimately contributing to "Healthy China" and "modernization of grassroots governance." This composite value orientation necessitates the establishment of a multi-dimensional indicator system for evaluating transformation effectiveness, moving beyond simple economic accounting.

3. Basic Logic: Nested Dynamic Drivers and Operational Mechanisms

The practice of transforming sports science and technology achievements in the process of Chinese modernization follows a unique and self-consistent basic logic. This logic is a complex system consisting of multi-level, nested, and dynamically interwoven target logic, driving logic, process logic, and value logic [8]. Target logic constitutes the meta-traction force and value origin of the entire transformation system. The fundamental starting point and ultimate destination of all transformation activities are closely anchored to the grand blueprint and phased strategic tasks of Chinese modernization. This means that the selection of sports science and technology achievements, the establishment of research and development directions, and the choice of transformation paths must first serve national objectives such as building a sports power, the Healthy China strategy, promoting common prosperity, and enhancing cultural confidence. Guiding documents like the Outline for Building a Leading Sports Nation issued by the state set a clear strategic framework and priority sequence for transformation activities. This powerful strategic target traction ensures that limited innovation resources can be focused on areas of greatest national urgency and public concern.

Under the guidance of clear targets, driving logic explains how the system operates and where its energy originates. Its core is the dual-engine structure formed by "strategic demand traction"

and "market mechanism drive," which exhibits dynamic complementary relationships in different fields and stages. In areas with strong public goods attributes, high investment risk, unclear short-term market returns, and urgent tasks related to major national prestige, strategic demand traction dominates. The government creates "demand-side pull" by establishing national major science and technology projects or directly procuring services, pushing scientific and technological achievements from laboratories to designated application scenarios. In highly marketized areas such as consumer-grade smart wearable devices and fitness entertainment applications, market mechanisms become the main driving force. Enterprises' pursuit of profit, consumers' scrutiny of product experience, and capital's expectation of investment returns collectively form a powerful "market push." The government can reduce early-stage risks for market entities and guide market forces toward strategic areas through policy tools like R&D subsidies and innovation vouchers; meanwhile, successful market transformation cases can provide references for the government to plan subsequent strategic priorities, forming a "strategy-market" feedback loop.

The actual operation of the system is depicted by process logic, which presents a complex picture of "networked symbiosis and iterative evolution." Transformation does not proceed along a preset linear pipeline. On the contrary, it occurs within dynamic networks composed of multiple actors, filled with feedback, leaps, and reconstruction. A specific product problem originating from an enterprise may trigger entirely new basic research; a prototype technology from a laboratory may involve athletes, coaches, and others in testing and improvement early on; during the promotion stage, user data and behavioral feedback directly become inputs for product iteration and next-generation R&D. In this process, data, as a new key factor of production, increasingly highlights its logic. Various types of data generated by sports, after compliant collection and anonymized analysis, can not only optimize individual training and fitness plans but also aggregate into valuable resources for gaining insights into industry trends and supporting public policy formulation. Therefore, constructing secure, trustworthy, and efficient data circulation and utilization mechanisms has

become a core issue in optimizing process logic. Ultimately, the effectiveness of all activities is subject to the test and feedback of value logic. This logic emphasizes the composite, long-term, and cyclical nature of value. First, value is multi-dimensional and composite; successful transformation needs to achieve balance or synergy across multiple value dimensions such as strategy, economy, society, and culture. Second, value realization is long-term. Many transformations, especially those aimed at changing behavioral patterns and improving public health, require years or even longer for their social benefits to fully manifest. Finally, and most characteristically Chinese, is the expansion-feedback spiral of value. For example: national resources support the R&D and transformation of a key technology for competitive sports (achieving strategic value)→after adaptive improvement, the technology is launched into the mass consumer market, becoming a popular product (achieving economic value and generating social value)→the massive public sports data accumulated by the product, after analysis and mining, feeds back into and optimizes national team training models (enhancing strategic value), while simultaneously giving rise to new business formats like data analysis services (new economic value). This phenomenon of value circulating and continuously amplifying among different fields and actors is the highest-level manifestation of the health and vitality of the sports science and technology achievement transformation ecosystem.

4. Practical Paths: Multi-level, Differentiated Collaborative Promotion Strategies

Based on a profound grasp of the essential characteristics and basic logic of sports science and technology achievement transformation in the process of Chinese modernization, constructing its efficient practical paths must abandon the simplistic "one-size-fits-all" thinking and adopt a differentiated, systematic strategy featuring multi-level design, multi-actor collaboration, and multi-scenario adaptation [9]. This path system can be collaboratively developed at the macro, meso, and micro levels. At the macro level, the core tasks are optimizing top-level design, solidifying the institutional foundation, and shaping a favorable ecosystem. This requires transcending departmental perspectives for systematic national-level

planning and coordination. First, research should be conducted to formulate a Special Plan for Sports Science and Technology Innovation and Achievement Transformation Towards 2035, clarifying phased goals aligned with the national modernization process, key areas, and resource allocation principles. Second, it is imperative to accelerate the improvement of the legal guarantee system, with the key being revising supporting implementation rules for the Law on Promoting the Transformation of Scientific and Technological Achievements in the sports field, thoroughly resolving long-standing issues concerning the ownership definition, disposal rights, and income distribution of job-related scientific and technological achievements in universities and research institutes, and promoting the establishment of a due diligence exemption mechanism. Simultaneously, accelerate the formulation of standards in areas such as smart sports equipment and sports data security. Third, innovative cross-departmental collaborative governance mechanisms need to be established, potentially exploring the establishment of an "Inter-ministerial Joint Conference System for Sports Science and Technology Development" involving multiple departments. Finally, a strategic layout of a batch of national-level, open, and shared sports science and technology innovation platforms should be established to provide public services such as basic research, generic technology R&D, and inspection and testing for the entire industry. At the meso level, the focus lies on innovating market mechanisms, cultivating professional elements, and smoothing transformation channels [10]. First, it is essential to deepen the reform of science and technology evaluation and incentive mechanisms. In universities and research institutes, resolutely reverse the tendency of "valuing only papers and professional titles," making the actual benefits obtained from the transformation of scientific and technological achievements one of the core evaluation indicators. Comprehensively promote the reform of the rights to use, dispose of, and benefit from scientific and technological achievements, implementing policies that allocate no less than 70% of transformation income to the R&D team. Second, vigorously develop a diversified financial support system adapted to the characteristics of sports science and technology. Promote the establishment of a national-level guiding fund for sports science

and technology achievement transformation to attract and leverage more social capital into early-stage investment in sports technology. Encourage commercial banks to develop financial products like intellectual property pledge loans and support insurance institutions in developing relevant insurance varieties. Explore paths for asset securitization based on future project revenue rights or intellectual property. Third, vigorously cultivate professional technology transfer institutions and talent teams, fostering interdisciplinary "technology managers." Encourage the establishment of industry-specific platforms for releasing and trading scientific and technological achievement information. Finally, cautiously and actively explore the cultivation of a market for sports and health data elements. Under the premise of ensuring personal privacy and data security, research and formulate basic systems such as data property rights and circulation transactions, promoting the orderly sharing and integrated utilization of data within a compliant framework.

At the micro level, key measures involve stimulating the vitality of various actors, strengthening scenario-driven approaches, and implementing precise policies. The primary task is to empower diverse innovation actors in a categorized manner. For researchers, not only should their benefit rights be guaranteed, but procedures for part-time employment, concurrent positions, and leaving posts to start businesses should be simplified, providing entrepreneurial guidance and support. For enterprises, especially small and medium-sized ones, tax incentive policies like additional deductions for R&D expenses should be implemented, supporting them in forming innovation consortia with universities and encouraging leading enterprises to open up their supply chains and innovation resources. Actively cultivate and develop a batch of new-type sports R&D institutions with mixed ownership, mission-oriented, and market-oriented operations. Secondly, strengthen the driving and demonstrative role of application scenarios. Vigorously promote the model of "organizing R&D and transformation around major tasks and scenarios." For example, using major events as opportunities to establish science and technology special projects, concentrating efforts to overcome key technologies and apply and verify them during the events, and promoting their

transformation to public fitness and the sports industry afterwards. Plan demonstration projects such as smart fitness parks and digital sports communities in urban renewal and community construction. The government can provide initial market support for innovative products and services through methods like first purchases and ordering. Finally, differentiated transformation paths must be implemented: for core technologies in the field of competitive sports, a "national task-driven" path is appropriate; for achievements in the field of public fitness and health promotion, a "public service traction" path is suitable; for achievements in the field of sports consumption and equipment manufacturing, a "market demand pull" path should be firmly adopted.

5. Conclusion

In summary, the transformation of sports science and technology achievements in the process of Chinese modernization is a strategically systematic project rich in connotation, unique in logic, and complex in path. Its essence is a systemic innovation practice defined by both national strategy and people's needs, unfolding under unique institutional advantages; its logic presents a multi-level, nested, and dynamic interplay of target traction, dual-wheel drive, networked symbiosis, and value circulation; its path requires synergistic design and precise policy implementation at the macro, meso, and micro levels. In-depth research on this subject reveals that the key to the success of the "Chinese paradigm" for sports science and technology achievement transformation lies not in simply imitating international experiences of technology transfer, but in whether it can deeply understand and organically integrate the efficiency of an "effective market" with the responsibility of a "proactive government," whether it can adhere to the fundamental stance of "putting people at the center" while pursuing the frontiers of science and technology, and whether it can build a synergistic and symbiotic innovation ecosystem while stimulating individual creativity. Looking ahead, with the deepening of the technological revolution and industrial transformation, and the continuous advancement of Chinese modernization goals, sports science and technology achievement transformation will inevitably face more new opportunities and challenges.

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