

Digital-Intelligent Technology Driving the High-Quality Development of the Sports Industry: Mechanisms and Implementation Path

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Abstract. The swift progress of the latest wave of industrial transformation and technological revolution, coupled with the rapid development of digital-intelligent technology clusters, has enabled China's sports industry to shift from scale expansion to quality improvement. However, during the process of implementing technology empowerment, the industry faces practical bottlenecks, including inadequate infrastructure, a shortage of comprehensive talent, and insufficient technological integration. Moreover, existing research suffers from scattered perspectives and insufficient attention to the governance dimension. Based on this, this paper adopts the methods of literature review and logical analysis to systematically explain the theoretical basis of digital-intelligent technology and the high-quality development of the sports industry, and to thoroughly analyze its mechanisms from three dimensions: technological innovation, data and talents, and product innovation. According to the study, the sports industry's superior development is fueled by digital-intelligent technology following a four-level progressive logic of "technology empowerment - element reconfiguration - business format emergence - governance optimization". To resolve the triple dilemmas, this paper proposes collaborative paths including consolidating the digital-intelligent infrastructure foundation, deepening industrial integration, building a comprehensive digital-intelligent talent cultivation system, and improving the digital governance system, in order to provide theoretical support and practical guidance for the digital-intelligent transformation of the sports industry.

Keywords: Digital-intelligent technology, high-quality development, sports industry, dilemma, implementation path

1. Introduction

With the accelerated evolution of the new round of technological revolution and industrial transformation, digital-intelligent technology clusters such as 5G, artificial intelligence, big data, blockchain, and the metaverse have developed rapidly and gradually penetrated into multiple aspects of the sports industry, including sports manufacturing, sports consumption, and sports services. By changing production methods, organizational structures, and resource allocation mechanisms across various industries, these technologies have steadily shifted the social economy from digitization and

networking toward a digital-intelligent transformation stage characterized by intelligent decision-making and data-driven processes. Digital-intelligent technology is the product of the deep integration of "digital technology" and "intelligent technology"; its core essence lies in the intelligent collection, processing, analysis, and mining of large-scale and multi-dimensional data, thereby achieving precise perception, scientific decision-making, dynamic optimization, and intelligent execution of complex systems. At the same time, China's sports industry is in a critical period of transformation from scale expansion to quality improvement. The Outline for Building a Strong Sports Nation issued by the General Office of the State Council in 2019 clearly proposed to accelerate the deep integration of the Internet, big data, and artificial intelligence with the real economy of sports; the 14th Five-Year Plan for Sports Development further stressed promoting the digital transformation of the sports industry. In 2025, the Opinions on Unleashing the Potential of Sports Consumption and Further Promoting the High-Quality Development of the Sports Industry, issued by the General Office of the State Council, proposed that by 2030, the sports industry's development level will have significantly improved, with a total scale exceeding 7 trillion yuan, setting clear goals for the high-quality development of the sports industry. Against this era context, digital-intelligent technology has evolved from a single auxiliary tool to a strategic force promoting the transformation of sports industry production methods, expansion of consumption scenarios, and enhancement of governance models.

However, in the process of using digital-intelligent technology to support the sports industry's high-quality development, there are still several practical bottlenecks such as inadequate infrastructure, a shortage of comprehensive talent, insufficient industrial integration, and an incomplete regulatory system. These problems require a systematic explanation of the mechanisms and implementation path of the role of these technologies from a theoretical perspective. Currently, active research on high-quality development of the sports industry from the perspectives of digital economy-driven development, the empowerment of new productive forces, and the application of artificial intelligence has been conducted by scholars. Nevertheless, these perspectives remain scattered, lacking effective integration of their logical interconnections and synergistic effects, and have yet to form a systematic analysis framework that bridges "technology empowerment - element reconfiguration - governance adaptation". Moreover, the exploration of the digital governance dimension in existing research is still relatively weak, and the attention to the relationship between institutional adaptation and the mutual construction of digital technologies is significantly insufficient. This coexistence of "fragmented perspectives" and "governance absence" makes the mechanism of the digital transformation of the sports industry lack a complete explanation. Thus, it is urgent to construct a theoretical model that integrates multiple dimensions and incorporates governance logic into the analytical framework. Based on this, this paper adopts the methods of literature review and logical analysis to systematically sort out the theoretical basis of digital technologies for the integrated development of the sports industry, deeply explain the mechanism by which digital technologies drive the high-quality development of the sports industry, comprehensively analyze the current dilemmas, and propose feasible implementation paths, providing theoretical references and practical guidance for the digital transformation of the sports industry.

2. Theoretical overview of digital-intelligent technology and high-quality development of the sports industry

2.1. Definition of core concepts

Digital-intelligent technology is the product of the deep integration of "digital technology" and "intelligent technology". It is not a single technology but encompasses a cluster of new technologies, including artificial intelligence, big data, cloud computing, the Internet of Things, 5G/6G, and blockchain. Its key lies in achieving data interconnection, algorithm synergy, and scenario adaptation among technologies. The evolution from "digitization" to "digital-intelligent transformation" can be essentially understood as the relationship between "eyes" and "brain": Digitization mainly addresses the issues of the recognizable and recordable nature of real-world information, that is, converting objective world information into data that can be identified by computers; whereas digital-intelligent transformation addresses issues such as pattern discovery, decision optimization, and execution control, that is, enabling machines to find patterns from data and then feed them back to real-world production, management, and services, thereby forming a closed-loop of self-optimization. The core essence of digital-intelligent technology lies in the intelligent collection, processing, analysis, and mining of massive and multi-dimensional data, achieving precise perception, scientific decision-making, dynamic optimization, and intelligent execution of complex systems [1].

The connotation of high-quality development of the sports industry mainly includes three dimensions: economic benefits, social benefits, and ecological benefits [2]. The economic benefits dimension requires the industry to ascend from the lower end of the value chain to the higher end, achieving simultaneous improvement in scale expansion and profitability; the social benefits dimension emphasizes the universal accessibility of sports services, promoting the deep integration of fitness and health for all people, and laying solid foundation for the construction of a Healthy China; It requires the use of technological means to propel energy-saving management of venues, green operation of events, and resource recycling, guiding society toward green and healthy lifestyles, and realizing a positive interaction between the development of the sports industry and environmental protection.

2.2. Theoretical foundations

The Total Factor Productivity (TFP) theory provides a core indicator for measuring the effectiveness of industrial transformation and upgrading. Digital technology has become a key path to enhance the total factor productivity of the sports industry through optimizing the efficiency of element allocation, promoting technological innovation and organizational changes [3]. The theory of industrial integration holds that, based on a common technological foundation or market ties, different industries could achieve the dissolution and reconfiguration of industrial boundaries through technological penetration and business reorganization, which provides theoretical support for explaining the integrated development of sports with cultural tourism, health, media, education, and other industries. Digital governance theory stresses that the use of digital technologies and data resources can reshape governance models, achieving more efficient and precise decision-making and service levels, which is highly consistent with the cross-boundary and platform-based characteristics of the digital development of the sports industry [4].

3. Mechanisms of digital-intelligent technology driving high-quality development of the sports industry

3.1. Technological innovation driving precision governance and business format innovation

Technological innovation serves as the primary driving force behind digital-intelligent technology empowering high-quality development of the sports industry, mainly reflected in the upgrading of governance methods, innovation in industrial business formats, and reconfiguration of consumption experiences [5]. In terms of governance, the "technological matrix" composed of intelligent technologies such as Internet of Things sensors, smart wearable devices, and cloud computing platforms enables governance subjects to collect real-time data throughout the entire chain, propelling the shift of management decisions from "experience-driven" to "data-driven", thereby reducing resource consumption and optimizing resource allocation. For example, some towns have established "sports public service intelligent platforms" that can achieve precise allocation of public sports resources by integrating services such as "venue reservation" and "sports training registration" [6].

In regard to business format innovation, virtual reality devices and intelligent fitness scenarios provide users with immersive experiences; 5G/6G technologies ensure ultra-high-definition and low-latency remote live broadcasts and interactive features for sports events; as for blockchain technology, it has expanded the profit channels of the industry in sports copyright protection and digital collectibles transactions. These new business formats are driving the sports industry to transform from traditional models to digital and intelligent directions [7].

3.2. Data and talent driving resource allocation optimization

In the digital-intelligent era, data has become an innovative factor driving high-quality development of the sports industry. At the governance efficiency level, data resources can alleviate the problems of fragmented information and delayed decision-making. By establishing a unified and standardized cross-dimensional data platform, fragmented information can be integrated into a "sports data panoramic view" to improve the efficiency of resource allocation [4]. At the industrial output level, sports manufacturing firms leverage the data of user feedback and production line sensor to identify consumers' consumption preferences and production bottlenecks of the manufacturing plants, thereby realizing rapid product iteration and flexible production, reducing inventory waste and improving the returns on capital; while sports service enterprises like event companies and gyms, analyze user behaviour data to stratify consumers, provide personalized service packages, increase consumer retention rates, and optimize the scheduling of coaches, venues, etc., to maximize operational efficiency [8].

Meanwhile, talent is also a critical element in promoting the construction of the digital governance system for the sports industry. In the digital-intelligent era, digital governance of sports needs professionals who possess not only a deep understanding of sports principles but also digital skills [9]. Such talents can deeply discover the value of sports data and act as catalysts for industrial innovation, breaking down the cognitive barriers between sports and fields of technology and entertainment, and uniting the innovative efforts across the entire industry chain.

3.3. Product innovation and precise supply-demand matching

Product innovation serves as both an important carrier for the deep integration of digital-intelligent technologies with the sports industry, and a key link in converting digital-intelligent value into market value [7]. Driven by digital-intelligent technology, the transformation of sports products has the following three major trends: Firstly, physical products are becoming increasingly intelligent, such as embedding sensors in sports equipment, transforming them from single consumable items into intelligent terminals that can record sports data, provide training status feedback and offer health management suggestions; Secondly, the digitization of service products, for example, online fitness courses and other similar products have broken the traditional physical boundaries, allowing users to enjoy such services at home; Thirdly, the emergence of the "product-as-service" model. Unlike the traditional sales model of "one transaction, termination of rights and responsibilities", in this model, product delivery is only the starting point of the relationship with users. Enterprises leverage the personalized data reflected through the platform to provide consumers with continuous, adaptive health management services, thereby achieving the value extension from "selling products" to "selling services" [10].

As for the supply-demand aspect, the intellectualization of the operation logic is the key to solving the problem of mismatch between supply and demand in the sports industry. On the demand side, artificial intelligence and big data are leveraged to create refined user profiles and predict consumption trends, allowing a transition from "sampling inference" to "full-quantity perception"; while on the supply side, intelligent manufacturing is relied upon to achieve small-batch customized production, and real-time and efficient matching of supply and demand is achieved through recommendation algorithms. Moreover, based on user feedback data, the algorithm model is continuously optimized to form a self-updating precise matching loop.

In summary, the mechanism by which digital-intelligent technologies drive the high-quality development of the sports industry can be summarized as "Technology empowerment - Element reconfiguration - Business format emergence - Governance optimization" [11]. The technical layer provides infrastructure support for industrial transformation; factors such as data and talent realize value release driven by technology, converting technological potential into industrial momentum; these factors, in return, give rise to new business formats like intelligent products and integrated services, making digital-intelligent value concrete in the market; finally, digital governance ensures orderly operation across all levels while also promoting technological innovation and industrial upgrading.

4. Practical dilemmas of digital-intelligent technology driving high-quality development of the sports industry

4.1. Inadequate infrastructure

Digital- intelligent infrastructure is a prerequisite for the digital transformation of the sports industry; however, there is still a gap between the current construction level and the actual demand for high-quality development of the sports industry. On the one hand, regional development is extremely unbalanced, with insufficient network coverage in certain small and medium-sized cities and rural areas, resulting in a digital divide. It severely affects the equalization of public sports services between urban and rural areas. On the other hand, the construction cost of smart stadiums is high with a long return period, and most venues still rely on traditional operation models, making it difficult to meet the digital-intelligent training, viewing, and consumption demands of customers

[6]. Before the construction of the integrated big data platform for the sports industry, each region's platforms operated independently, leading to repeated construction and resource waste, which directly restricted the wide deployment and deep application of digital technologies in the sports industry.

4.2. Insufficient supply of comprehensive talent

The shortage of comprehensive talent is one of the most prominent bottlenecks in empowering the sports industry with digital-intelligent technology. The talent cultivation models for related majors in university sports industries mostly still rely on traditional teaching methods, with relatively insufficient curriculum offerings in digital-intelligent technology, leading to graduates in this field lacking the application ability of digital-intelligent technologies and struggling to adapt to the demands of industrial digital-intelligent transformation. Meanwhile, talents in the digital-intelligent field tend to flow to high-paying industries such as the internet and finance, while sports enterprises offer relatively low salaries and lack competitiveness, making it difficult to recruit professional talents with digital-intelligent skills [6]. Moreover, some enterprises have insufficient understanding of digital-intelligent transformation, and have not established a training and assessment mechanism for digital-intelligent skills within the organization. This makes it difficult to improve the digital-intelligent capabilities of current employees, further exacerbating the structural shortage of talent.

4.3. Insufficient deep integration of digital-intelligent technology and the sports industry

There is still a certain degree of disconnection between the application of digital-intelligent technology and the development needs of the sports industry; that is, some projects have introduced digital-intelligent technology in form but have failed to substantially change the sports products, service provision, and operational models [1]. For example, some red sports tourism projects have used VR technology to change the experience method, but they merely rely on panoramic software to display static photos, lacking narrative scenarios and interactive elements, thus failing to meet users' demands for immersive consumption. In the field of digital collectibles, a large quantity of products are only the digital "replication" of sports resources, lacking the capacity for secondary creation. Additionally, in the process of transformation, there is an oversupply of homogeneous and low-end products, while high-quality and personalized products are scarce, which fails to meet the increasingly diverse demands of consumer groups [1].

5. Implementation paths for digital-intelligent technology driving high-quality development of the sports industry

5.1. Consolidation of the digital-intelligent infrastructure foundation

In response to the dilemma of inadequate digital-intelligent infrastructure, the government and the market need to work together, with the government focusing on policy guidance, capital investment, and rule formulation, while market subjects emphasize technology application, service improvement, and operational innovation. The government should increase policy guidance and financial support, incorporate digital-intelligent infrastructure into the construction of the public sports service system, and encourage the participation of social capital. Simultaneously, the construction of city-level sports data hubs and business hubs should be accelerated, forming unified, standardized, and reusable data asset libraries, so as to achieve cross-departmental and cross-

regional data integration and sharing, providing technical support for precise governance and efficient operation. Additionally, the government needs to promote regional coordinated development, increase assistance for central and western regions and rural areas, and leverage policy preferences and financial support to narrow the digital gap between regions [12]. As for the difficulty of transforming traditional venues, a phased renovation strategy can be adopted, prioritizing the deployment of basic intelligent systems such as intelligent lighting and crowd monitoring, gradually transitioning from traditional operations to digital-intelligent operations.

5.2. Deepening of industrial integration

To address the dilemma of insufficient deep integration between digital-intelligent technology and the sports industry, the key lies in identifying the appropriate application scenarios for technologies and shifting from a superficial combination of digital-intelligent technologies and sports programs to a deeper integration among technological logic, sports content, and consumer demands [1, 6]. The sports manufacturing industry should focus on consumers' demands for interactive experiences and personalization, increase investment in research, develop intelligent sports equipment, and establish closed-loop analysis models based on sales data and usage process data to provide evidence for product iteration [8]. Meanwhile, the sports service industry should expand integrated business formats such as "sports+tourism" and "sports+health". For instance, event operators promote standardized data collection and open sharing, developing value-added services like virtual viewing and data interaction; fitness service platforms offer personalized training schedules according to user data to enhance user stickiness. At the same time, data sharing and business collaboration among events, venues, and training institutions should be promoted to build a full-chain data circulation network. In terms of consumption scenarios, attention should be paid to the digital sports consumption characteristics of young groups, and high-density sports consumption destinations need to be created that integrate viewing, experience, and interaction [1].

5.3. Construction of a comprehensive digital-intelligent talent cultivation system

To address the issue of insufficient supply of talents in the sports industry, the government, universities, and enterprises should work together [9]. Universities need to add digital-intelligent courses such as artificial intelligence and big data analysis to talent cultivation programs, construct a cross-disciplinary training mechanism of "sports+technology+management", and simultaneously introduce project-based teaching and practical training in enterprises centered on real industrial problems, achieving an effective connection from "knowledge acquisition in the classroom " to "practical ability development". Enterprises should incorporate digital literacy into the job compatibility assessment, establish a regular training and assessment mechanism, and formulate differentiated training plans for management, technical and operational levels, deepening cooperation with universities and research institutions and establishing joint laboratories and research centers together. As for the government, it should improve policies for attracting and motivating digital-intelligent talents, providing support in terms of settlement, housing and salary, and jointly establish a talent information service platform with industry associations, facilitating precise matching of supply and demand and alleviating the structural contradiction of difficulties in both sports enterprise recruitment and digital-intelligent talent employment.

5.4. Improvement of the digital governance system

In response to issues such as data security, algorithm risks, and cross-border supervision emerging during the digital-intelligent transformation of the sports industry, the modernization of governance needs to be advanced in a coordinated manner from the aspects of subjects, systems, and structures [2, 4]. At the governance subject level, a diversified and collaborative governance pattern should be constructed, where the government is responsible for rule-making and service guarantee, enterprises undertake the responsibilities of data compliance and technology application, and social organizations and users participate in feedback and supervision. Meanwhile, digital technology should be utilized to achieve "two-way interaction" between the governance subjects and objects, that is, precise policy delivery and real-time feedback upload, transforming governance from one-way control to a multi-party interactive governance ecosystem. At the governance system level, a "soft-and-hard combination" system should be improved: hard constraints should be strengthened with regulations on data security and privacy protection, as well as algorithm auditing systems, to prevent algorithm discrimination and data abuse; soft constraints should encourage industry associations to formulate self-regulatory conventions and standard specifications, and strengthen technological ethics review. At the governance structure level, a three-dimensional regulatory mechanism should be constructed that integrates "online and offline, industry and comprehensive supervision collaboration, and the connection of pre-event, in-event and post-event supervision ", establishing cross-departmental data sharing and joint law enforcement platforms, implementing differentiated targeted supervision based on enterprise credit and risk profiling, and ensuring the sustainable and stable development of the sports industry while promoting innovation and growth [4].

6. Conclusion

This paper draws the following conclusions: Firstly, the mechanism by which digital-intelligent technology drives the high-quality development of the sports industry follows a four-level progressive logic of "technology empowerment - element reconfiguration - business format emergence - governance optimization", with each level mutually promoting and evolving collaboratively. Secondly, digital-intelligent empowerment of the sports industry faces triple changes of inadequate infrastructure development, shortage of comprehensive talents, and insufficient integration of technology and industry. Thirdly, the implementation path requires multi-dimensional strategies, such as laying a solid foundation at the technical level, deepening integration at the industrial level, building cultivation systems at the talent level, and improving governance systems at the governance level. Only by forming a synergy can the potential of digital-intelligent technology be effectively transformed into practical outcomes for high-quality development of the sports industry.

Future research can be further developed in the following directions: conducting tracking studies on the long-term impact of digital-intelligent technology on the sports industry to provide empirical evidence for causal relationship inference; exploring the capitalization of sports data and the marketization mechanism of data elements, and researching data ownership, pricing, and transaction rules; paying attention to the ethical governance issues of the application of generative artificial intelligence in the sports industry, including issues such as data privacy protection and the boundary of human-machine collaboration; and promoting interdisciplinary collaborative research in sports studies, economics, data science, and public administration, to build a more complete research paradigm and theoretical systems for sports digital-intelligent transformation.

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