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Designing a Model to Improve the Performance of Sustainable Sports Product Supply Chains Based on Innovation and Digitalization

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A B S T R A C T

This study aimed to design a model for improving the performance of sustainable sports product supply chains based on innovation and digitalization. The research employed a qualitative method and a grounded theory approach (Strauss & Corbin) to identify hidden processes and patterns within sports product supply chains in Iraq. Data were collected through semi-structured interviews with 16 key stakeholders, including manufacturers, distributors, and consumers, and analyzed using three-stage coding to develop a theoretical model based on real data. The findings indicate that causal conditions or necessities include the adoption of emerging technologies and process innovations, which lead to digitalization, transparency, and improved decision-making in sports product supply chains. Additionally, contextual or facilitating factors, such as technological infrastructure and legal and policy support, facilitate the successful implementation of these technologies and innovations. However, intervening factors or barriers, including organizational resistance and poor coordination among supply chain components, can limit the execution of technological strategies. The core phenomenon of the study is the "performance of sustainable sports product supply chains," which served as the focus of analysis, and the strategies identified include sports innovation management and supply chain collaboration. Ultimately, the outcomes indicate enhanced organizational performance and the achievement of sustainable competitive advantage in the sports industry. Therefore, implementing digital order management and smart warehousing systems, forming specialized innovation teams, and strengthening collaboration among stakeholders are recommended as practical strategies for improving performance and sustainability in sports product supply chains.

Keywords: *Sustainable Supply Chain, Innovation, Digitalization, Sports Management, Organizational Performance*

1. Introduction

In today's world, the limitation and depletion of natural resources has become a serious concern. To preserve ecological balance, the United Nations has designed 17 Sustainable Development Goals (SDGs) (Rehman Khan et al., 2022). In this context, the Supply Chain (SC) is of paramount importance, particularly for understanding the

impact of internet-based technologies on supply chain stakeholders, including suppliers, manufacturers, and customers (Qureshi et al., 2023). The Sustainable Supply Chain (SSC), as a fundamental pillar in the sports industry, seeks to balance economic, social, and environmental needs (Mohammadi et al., 2024).

Given the ever-increasing demand for sports products and growing consumer awareness of environmental issues, the necessity to improve supply chain performance in this domain is felt more than ever (Hoffa-Dabrowska & Grzybowska, 2020). Organizations face pressure from stakeholders to implement sustainable practices, and studies in this area have particularly focused on novel technologies and sustainable innovation (Barreto et al., 2024). These innovations should not only seek to create competitive advantages for organizations but also contribute to improving environmental conditions and social welfare (Cillo et al., 2019). For this reason, many researchers in recent decades have examined the sustainable supply chain (Beske et al., 2014; Brandenburg et al., 2014; Carter et al., 2019). This research investigates the challenges and opportunities within the sustainable supply chain for sports products in Iraq and seeks to identify effective strategies for improving this chain by leveraging modern technologies. To achieve sustainable supply chain growth and related sustainable development, inclusive engagement with advanced digital stakeholders is crucial (Rehman Khan et al., 2022). Emerging technologies such as blockchain, AI, and IoT are transforming supply chains, driving significant growth. Building strong digital capabilities is essential to unlocking their potential. Smart supply chains, through features like intelligent analysis, optimized decision-making, and automated error correction, enable dynamic adaptation to changing conditions (Subramanian et al., 2025). Cloud computing facilitates information sharing among supply chain partners, thereby improving supply chain performance (Cao et al., 2017).

Data collection, whether from the service or manufacturing sector, is rapidly expanding to make BDA suitable for effective management of the manufacturing supply chain (Zhang et al., 2018). However, implementing BDA in sustainable supply chains poses multiple challenges for manufacturing companies that require complementary capabilities (Edwin Cheng et al., 2022). Supply chain performance is improved through the use of BC technology by mitigating the negative consequences of information asymmetry (Longo et al., 2019). Furthermore, AI in the manufacturing supply chain aids in system automation and manages production lines optimally, error-free, and without waste. Finally, CPS has provided a prominent foundation for building advanced industrial systems and applications. This has been made possible by integrating innovative capabilities through IoT and the Web of Things (WoT) (Lu, 2017). The research by Bagherpasandi et al. (2024), titled "Presenting a Model for Enhancing Sustainable Supply Chain Management Performance Using a Data-Driven Approach," identified motivational factors affecting the improvement of SSCM performance. The results indicate that attention to these factors when implementing sustainable supply chain systems can increase their efficiency and effectiveness and provide practical guidance for organizations (Bagherpasandi et al., 2024). Research by Mohammadi et al. (2024), titled "The Deep Connection Between Supply Chain and Knowledge Absorptive Capacity," showed that supply chain coordination and knowledge absorptive capacity have a positive and significant impact on sports product development performance. The findings emphasize that improving production processes and managing technical and managerial knowledge is essential for increasing efficiency and growth in the sports industry (Mohammadi et al., 2024).

Research by Memari et al. (2025), titled "Supply Chain Management: A Process for Optimizing Talent Identification and Development Management in Sports," showed that the interaction of the talent system with the environment, supply chain capacity, optimization methods, and the efficiency of talent development processes play a significant role in athletes' success. These findings emphasize that targeted management of the talent supply chain can strengthen the necessary motivation and support for nurturing sports talents (Memari et al., 2025). Research conducted by Barreto et al. (2024), titled "Sustainable Supply Chain Innovation and Market Performance: The Role of Sensing and Innovation Capabilities," showed that dynamic market sensing and innovation capabilities positively affect sustainable innovation practices in supply chains as well as market performance (Barreto et al., 2024). Attia and Uddin (2024) conducted research investigating a combined evaluation to enhance supply chain resilience and sustainability. The results of this study indicate that "Planning and Scheduling Efficiency" was identified as the best performance category, while "Collaboration and Communication" was introduced as the weakest category. Furthermore, the results show that the brainstorming process helped group facilitators into four distinct categories, thereby providing a structured framework for understanding

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and organizing these facilitators (Attia & Uddin, 2024). Research conducted by Qureshi et al. (2023), titled "Improving Sustainable Manufacturing Supply Chain Performance through Technology and Process Innovation Exploitation," indicates a positive relationship between new technologies and improvements in various supply chains. Additionally, these results show that novel technologies have a positive impact on process innovation, which consequently contributes to enhancing manufacturing supply chain performance (Qureshi et al., 2023).

Research by Rehman Khan et al. (2022) showed that sustainable development strategy and environmental innovation can only improve sustainable supply chain performance by leveraging digital transformation and green technology. The findings emphasize that combining smart and digital technologies with green innovations is essential for achieving sustainable development goals and sustainable supply chain efficiency (Rehman Khan et al., 2022). Fung (2021), in part of his research, investigated attitudes towards sustainable development in the sportswear industry. The results show that Big Data Analytics (BDA) enhances the resilience of the Sustainable Supply Chain (SSC), and different attitudes towards the sustainable design and production of sportswear products can provide strategic insights for improving management and business development (Fung, 2021). Many researchers have examined the role of various technologies on sustainable performance (Rehman Khan et al., 2022). For example, researchers found that in the supply chain domain, many supply chain members undertake sustainability efforts not only to help the environment but also to increase market demand (Hosseini-Motlagh et al., 2021). The results also indicate a positive relationship between new technologies and improvements in various supply chains. Furthermore, these results show that novel technologies have a positive impact on process innovation, which consequently contributes to enhancing manufacturing supply chain performance (Qureshi et al., 2023). Evidence shows that in recent years, the demand for integrating sustainability (including economic, social, and environmental pillars) into supply chain operations has increased (Ghadimi et al., 2019). In this regard, China, as the country with the world's largest supply chain system, encourages green technology innovation by transportation companies to promote supply chain sustainability (Li & Li, 2022). However, existing studies in this field lack quantitative analyses regarding the impacts of novel technologies and process innovations on the SSC in Iraq.

In recent years, corporate, social, and environmental responsibility have become part of the desired objectives of manufacturing and service organizations. Sustainability has positively become the norm for organizational activities. There are also other factors that drive organizations to use sustainable supply chain management, particularly in the upstream sections of the supply chain (Zhang et al., 2018). These factors can be internal or external. The benefits of sustainable supply chain management include: customer satisfaction, quality, innovation, trust, resource procurement speed, optimal inventory, flexibility, lead time, and cost control. These should be considered when using sustainable supply chain management incentives. There is also growing interest in the literature in expanding the scope of sustainable innovation analysis to all stakeholders, academics, and researchers (Ghadimi et al., 2019), seeking a deeper sharing of socio-environmental impact responsibilities among different organizations (Seuring, 2013). The concept of the Sustainable Supply Chain (SSC) was introduced and extensively examined by supply chain management researchers. Since then, researchers have analyzed issues related to the SSC from various aspects such as contract design, decision-making, pricing strategies, etc., concluding that technological innovation is a key factor in developing sustainable supply chains (Bai et al., 2020; Han & Wang, 2018; Zhang et al., 2018). Today, online shopping has become increasingly common. Manufacturers of low-carbon products sell them through online platforms. Thus, the manufacturer and the e-commerce platform form a low-carbon e-supply chain system. The manufacturer, striving to reduce carbon emissions, produces the products, and the online platform provides sales services (Han & Wang, 2018). Technological changes help all manufacturers overcome production deficiencies and achieve the best possible quality (Qureshi et al., 2023).

Therefore, a product manufactured using the same production equipment shows nearly identical quality, making competition for manufacturers based solely on quality features difficult. Manufacturers employ new technology to be the first to bring the product to market and gain maximum possible profit. Sudden technology-based disruption due to new technologies has put significant pressure on the manufacturing sector to update their current production technologies and align with the standards of the new era.

Iraq, as a developing country, faces numerous challenges in economic and social domains. In this context, the sports industry can act as a driving engine for the country's

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economic and social development. However, the inadequate performance of the sports product supply chain hinders the full productivity of this industry. Therefore, identifying and improving the sustainable supply chain using novel technologies not only helps improve the performance of this chain but can also lead to the country's sustainable development. This research examines how to improve the performance of the sustainable sports product supply chain using these technologies and innovations. In this regard, identifying the challenges and opportunities within the supply chain, particularly in the digital age, can help develop effective strategies. Also, given the diversity and complexities within the sports product supply chain, a comprehensive and multi-dimensional approach in this area is felt to be necessary. This research, using qualitative methods, analyzes and examines this subject and seeks to identify and improve various dimensions of the sustainable supply chain.

2. Methods and Materials

This study employed a qualitative method with a grounded theory approach, following Strauss and Corbin, to identify hidden processes and patterns within the sports product supply chain and to enable the extraction of a theoretical model based on real data. The statistical population consisted of key stakeholders in the sports product supply chain in Iraq, including manufacturers, distributors, and consumers.

Sampling for the qualitative section was purposive and included 16 experienced manufacturers with knowledge related to the supply chain, ensuring that the selected individuals had sufficient familiarity with the production, distribution, and supply chain management processes for sports products. Sampling continued until theoretical saturation was reached to extract all major patterns and themes. Data were collected through semi-structured interviews, with interview questions designed to extract participants' perspectives on modern technologies, process innovations, and sustainable supply chain performance. Each interview lasted between 45 and 60 minutes and was recorded and transcribed either in-person or online.

To enhance validity, triangulation techniques, participant feedback, and peer review were utilized. For reliability, test-retest reliability and inter-coder agreement assessment methods were employed to ensure that data coding was replicable over time and by different analysts.

Table 1

Inter-Coder Agreement Rate

Percentage of agreement	Number of agreements	Number of codes	Interview number
0.85	6	14	M3
0.82	7	17	M9
0.76	5	13	M14
0.81	18	44	Total

The data were analyzed using the three-stage coding process. First, in open coding, important phrases and sentences were identified and labeled. Then, in axial coding, these codes were organized, and main categories and relationships between concepts were extracted. Finally, in selective coding, the focus was on concepts related to the core phenomenon of the research, and the final theoretical model was formed.

The data analysis process included comparative examination among participants and extraction of common patterns and differences. Furthermore, ethical principles of human research were observed; informed consent was obtained from participants, and data confidentiality and anonymity were guaranteed. This process enabled the identification of key patterns, themes, and relationships between modern technologies, process innovations, and sustainable supply chain performance, providing the groundwork for presenting a localized and practical conceptual model. However, due to the qualitative nature of the research, its results are more suitable for in-depth understanding of concepts and processes and have limited generalizability.

3. Findings and Results

As shown in Table (2), a total of 16 key stakeholders of the sports product supply chain participated in the study. Participants included manufacturers, distributors, sales managers, marketing specialists, and professional consumers, each possessing significant experience and knowledge in activities related to the production,

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distribution, marketing, and supply chain management of sports products in Iraq.

Table 2

Characteristics of Research Participants

Number	Position or role in the supply chain	Activity history (years)	Organization type	How to participate	Gender
1	Sports equipment manufacturer	15	Private	In person	Man
2	Sales Manager of Broadcasting Company	10	Private	Online	Man
3	Sports Brand Marketing Manager	12	Private	In person	Woman
4	Regional distributor	8	Private	In person	Man
5	Sportswear manufacturer	20	Private	Online	Man
6	Raw material procurement expert	9	Private	In person	Man
7	Chain store logistics manager	14	Private	In person	Man
8	Professional consumer (club owner)	11	Private	Online	Man
9	R&D Manager	13	Private	In person	Man
10	Quality Control Expert	7	Private	Online	Woman
11	Manufacturer of fitness equipment	17	Private	In person	Man
12	Digital Marketing Expert	6	Private	Online	Woman
13	Local distributor	10	Private	In person	Man
14	Manufacturer of gym equipment	19	Private	In person	Man
15	Export Affairs Expert	8	Private	Online	Man
16	CEO of a sports manufacturing company	22	Private	In person	Man

Table 3 presents the results of the three-stage coding process (open, axial, and selective), developed based on the Strauss and Corbin approach. This table elucidates the relationships between causal conditions, contextual and intervening factors, strategies, and outcomes related to the performance of the sustainable sports product supply chain.

Table 3

Results of the Coding Process

Categories	Selective Codes	Axial Codes	Open Codes
Causal Conditions / Necessities	New Technologies	Digitalization of the Sports Supply Chain	Analysis of sales performance data of sports equipment, smart tracking of sports goods, use of blockchain for authenticity of sports brands, enterprise resource planning systems dedicated to sports retail stores
		Automation of Production and Distribution	Necessity of using robotics in packaging balls and sports shoes, 3D printing of shoes and protectors, necessity of warehouse automation in clubs, smart logistics of equipment, automatic quality-control machines
	Process Innovations	Optimization of Procurement and Distribution Processes	Demand forecasting systems for competitions, management of sports goods returns, smart distribution of online orders, use of consumer data
		Process Redesign	Redesigning the supply network of clubs, connecting domestic and foreign suppliers, modifying eco-friendly packaging processes, updating green transportation methods, coordination of research and production units
Contextual / Facilitating Factors	Technology Infrastructure	Sports Digital Platform	Creating a communication platform between manufacturers and clubs, developing order-management applications, connecting sports product databases, digital training systems for suppliers, sports Internet of Things
		Specialized Human Resources	Training workshop employees to use technology, improving digital literacy of coaches and sellers, recruiting sports-technology specialists, forming innovation teams in sports companies, encouraging lifelong learning
	Regulations and Policies	Sports Sustainability Regulations	Developing environmental regulations for producing sports shoes and apparel, green sports certifications, supportive policies for sports innovation, national safety standards for equipment, controlling non-standard imports

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		Financial and Institutional Support	Government investment in sports startups, support for sports innovation centers, providing financial facilities to equipment manufacturers, cooperation of federations with technology companies, joint university–industry research budgets
Intervening Factors / Barriers	Organizational Resistance	Traditional Culture in the Sports Industry	Dependence on old sales methods, fear of failure of new technology, distrust in smart systems, negative attitude toward automation, lack of motivation for change
		Weak Digital Skills	Lack of technical knowledge among production employees, inexperience in analyzing sales data, absence of artificial intelligence specialists in clubs, weakness in using digital platforms, employee resistance to training
	Supply Chain Coordination	Weak Collaboration Among Institutions	Lack of coordination between clubs and manufacturers, weak communication between federations and companies, absence of a data-sharing platform, lack of trust between local stores and brands, isolated policies
		Supplier Problems	Shortage of local raw materials, dependence on imported equipment, low quality of small-scale producers, high logistics costs, delays in order delivery
Core Phenomenon	Sustainable Performance of the Sports Supply Chain	Chain Efficiency and Flexibility	Improving customer order delivery time, reducing waste in sports production, increasing accuracy in sports inventory management, rapid response to market demand
		Environmental Sustainability and Brand	Use of recycled materials in shoes, reducing water consumption in sportswear production, green sports brand, customer satisfaction with sustainable products, increasing global credibility of the sports brand
Strategies	Sports Innovation Management	Development of Technological Products	Establishing an open innovation system to attract ideas from universities, startups, and sports teams; designing and launching green and smart production lines for sports equipment and apparel using recycled and low-consumption materials; creating an interdisciplinary research and development center in sports technologies; supporting local innovations in design, packaging, and distribution of sustainable sports products
		Technological Investment	Implementing sports Internet of Things in the distribution network for smart tracking of goods, creating a national database of customers and manufacturers of sports equipment for consumer behavior analysis, developing digital sales and marketing analytics platforms for demand forecasting and inventory control, attracting joint investment among the private sector, federations, and technology companies
	Supply Chain Collaboration	Synergy Among Sports Actors	Signing transparent and trust-based contracts between brands and clubs, forming a sports innovation association for synergy of ideas and transfer of technological experiences, launching a national information-exchange system for the sports supply chain to integrate data, developing shared logistics projects among sports companies to reduce cost and energy consumption
		Development of International Partnerships	Cooperation with sustainable foreign brands, participation in international exhibitions, technology transfer, export of green products, creating sports industrial clusters for developing innovative products
Outcomes	Improved Organizational Performance	Cost Reduction and Productivity Increase	Use of renewable energy in clubs and sports factories, reduction of fuel consumption in supply chain transportation, reduction of waste materials in sports equipment production, green product design for energy saving
		Increased Satisfaction of Sports Customers	Higher quality equipment, faster delivery to sports customers, better after-sales services, more attractive design of sports products, loyalty of sports customers
	Sustainable Competitive Advantage	Development of a Green Sports Brand	Formation of a green and technological brand identity in the domestic and international sports products market, effective differentiation from competitors through combining environmental values, increased domestic and export market share based on eco-friendly products
		Environmental and Social Sustainability	Reducing pollution from production of sports equipment and apparel through low-consumption technologies, developing waste management and recycling in clubs and sports factories, reducing energy and water consumption in sports production lines

The findings from the table indicate that the core phenomenon of the research, "Sustainable Sports Product Supply Chain Performance," is influenced by a set of causal, contextual, and intervening conditions, each playing an effective role in shaping the final strategies and outcomes. The analysis results suggest that the application of modern technologies such as digitalization, automation, and process innovations reinforces the necessity for transformation in the sports supply chain, while technological infrastructure and specialized human resources, as contextual factors, play a

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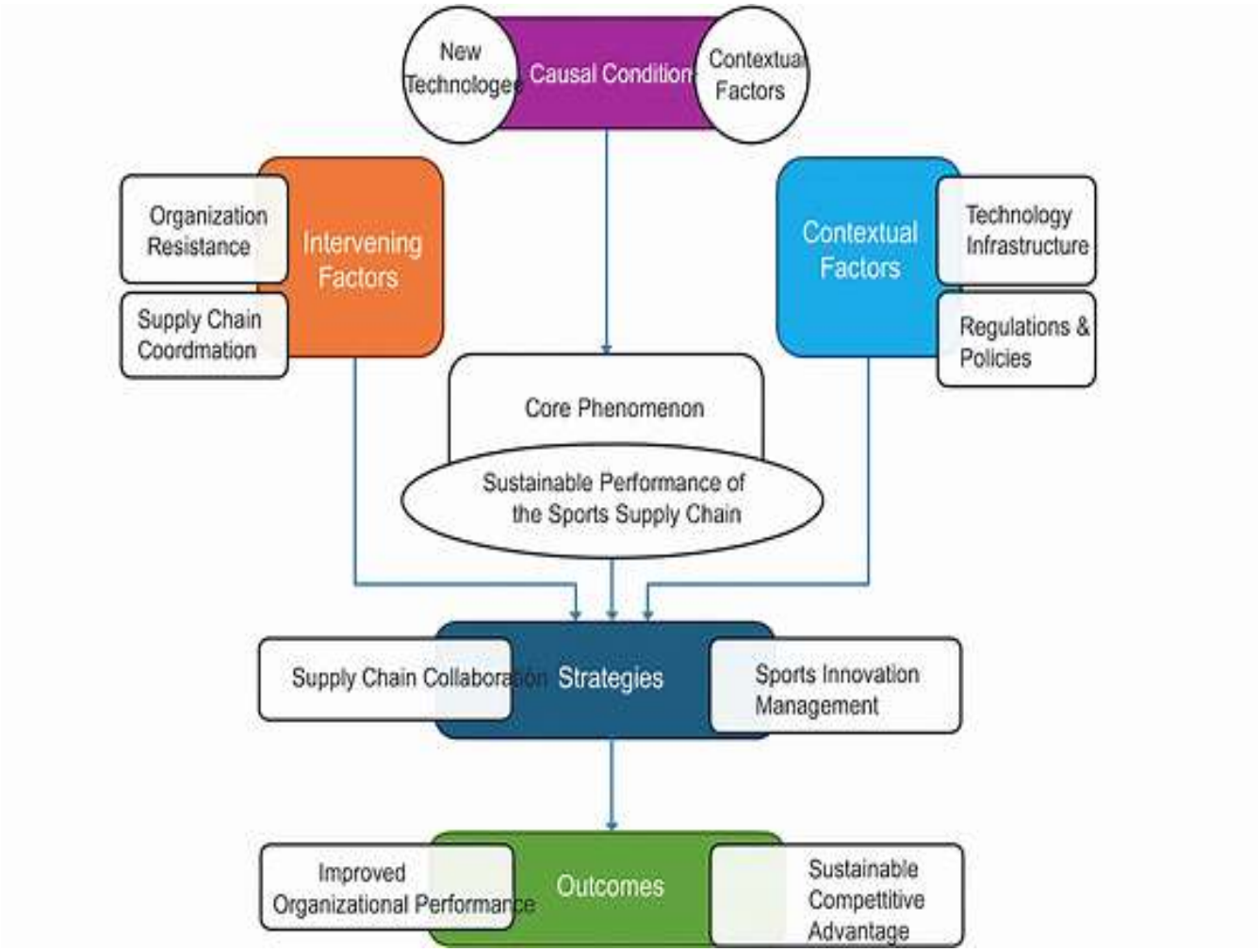
facilitating role in this process. Conversely, factors such as organizational resistance, weak digital skills, and lack of coordination among sports institutions were identified as the main obstacles. Adopted strategies such as sports innovation management, technological investment, and supply chain collaboration led to improved organizational performance, enhanced customer satisfaction, and the achievement of a sustainable competitive advantage. Ultimately, this interaction between technology, innovation, and inter-organizational cooperation contributed to the development of environmental and social sustainability in the sports industry.

Figure 1

Research Model (Derived from Research Interviews)



4. Discussion

The findings of this study illuminate the multifaceted dynamics underpinning the transition toward a sustainable and competitive supply chain within the sports products industry. The analysis, structured around causal conditions, contextual factors, intervening barriers, core phenomena, strategies, and consequences, presents a comprehensive model for understanding this transformation.

The centrality of technology adoption and process innovation as causal necessities confirms and extends existing literature (Rehman Khan et al., 2022). Digitalization tools (IoT, Blockchain, AI) and automation (robotics, 3D printing) are not merely incremental improvements but fundamental drivers that enhance transparency, speed, and accuracy. This aligns with global trends where digital integration is pivotal for supply chain resilience. However, this study specifically contextualizes these technologies within the sports industry, highlighting applications like

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smart tracking for athletic goods and blockchain for brand authentication, which address unique challenges of counterfeiting and product integrity.

The role of contextual and facilitating factors technological infrastructure, skilled human resources, and supportive policies emerges as critical. While technology provides the tools, its successful implementation hinges on these enablers. The emphasis on digital literacy for coaches and managers (Mohammadi et al., 2024) and the need for green certifications and governmental support (Barreto et al., 2024) underscore that technological transformation is as much a human and institutional challenge as a technical one. This finding suggests that investments in technology alone are insufficient without parallel investments in training and regulatory frameworks.

Conversely, the intervening barriers identified, such as organizational resistance rooted in traditional culture, skills gaps, and poor inter-organizational coordination (Qureshi et al., 2023), reveal significant implementation hurdles. These barriers often explain the gap between strategic intent and operational reality. The distrust among supply chain actors and dependence on imports point to deeper structural issues that require relational and systemic solutions beyond technological fixes.

The core phenomenon of Sustainable Supply Chain Performance is effectively framed as a multi-dimensional construct integrating efficiency, flexibility, and environmental/social responsibility. This aligns with contemporary supply chain paradigms that move beyond cost-centric models. The study's contribution lies in demonstrating how this performance is manifested in the sports industry through specific outcomes like reduced production waste for equipment and the development of a "green brand" identity, linking operational efficiency directly to market positioning and customer loyalty (Cillo et al., 2019).

The proposed strategies of innovation management, technological investment, and enhanced collaboration form a coherent action plan. The focus on open innovation involving universities and startups, and on forming national information exchange systems, highlights the importance of ecosystems and partnerships. This strategic framework bridges the identified causal conditions and contextual factors while directly addressing the noted barriers, offering a path from diagnosis to action.

The reported consequences improved organizational productivity, heightened customer satisfaction, and stronger environmental stewardship validate the proposed model. They demonstrate that the integration of digital and green innovations can create a virtuous cycle where operational benefits reinforce brand value and sustainability goals, ultimately contributing to broader SDGs (Rehman Khan et al., 2022).

5. Conclusion

This study concludes that the evolution of the sports products supply chain towards sustainability and competitiveness is a complex process driven by an interdependent set of factors. The fundamental imperative is the strategic integration of digital technologies and process innovations. However, this technological leap is contingent upon a supportive ecosystem comprising robust infrastructure, a skilled workforce, and enabling policies. Significant cultural, skill-based, and structural barriers must be proactively managed to prevent derailment.

The ultimate goal is the achievement of multi-dimensional supply chain performance, which synergizes operational excellence with environmental and social responsibility. This performance is not an end state but a dynamic outcome facilitated by deliberate strategies focused on fostering innovation, making strategic technological investments, and building collaborative networks across the supply chain.

The practical implications are clear. For managers and policymakers in the sports industry, success requires a holistic approach: simultaneously upgrading technology, investing in human capital, fostering a culture open to change, and building bridges of cooperation between all stakeholders. Future research could quantitatively test the relationships within this model or explore the specific implementation challenges of technologies like AI and blockchain in different segments of the global sports industry. Ultimately, embracing this integrated transformation is essential for sports brands to thrive in an increasingly digital and sustainability-conscious market.

Authors' Contributions

All authors contributed substantially to the study and to manuscript development, and all approved the final version.

Declaration

Artificial intelligence was used only for language polishing and editorial support during manuscript preparation. No AI tool was used for data collection,

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statistical analysis, or generation of the study results. The authors reviewed, verified, and take full responsibility for the final content of the manuscript.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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