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The Power of Artificial Intelligence on Sports

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 Abstract

This article explores the broader role that artificial intelligence (AI) will play in the changing sports industry, focusing on how it will impact areas such as player performance, management, strategy formulation, and access to fans. As demonstrated by technologies such as FIFA sideline technology and video-assisted refereeing (VAR), the fusion of artificial intelligence and sports is driving a redefinition of traditional concepts of justice and human decision-making, resulting in greater reliance on data and objective decision-making processes. The study identifies fundamental issues in the practical and economic elements of sports, including the utilisation of artificial intelligence (AI) and strategic planning. The present study traces the evolution of scientific discourse through a detailed literature analysis of AI in sports from 1975 to 2023. The present study explores the evolution of artificial intelligence applications and their influence on the digital economy. To this end, an investigation is conducted into patterns of academic publications, encyclopedia editions, and collaborative networks. A notable increase in academic demand has also been observed since 2017, suggesting a growing public awareness of AI's revolutionary potential. This study makes a theoretical contribution to the understanding of the integration of AI into the sports ecosystem. It has the potential to assist sports organisations and policymakers in addressing ethical issues and jobs created by the use of AI.

Keywords

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Introduction

The sports industry thrives on legendary athletes and rivalries, celebrated in popular culture and historical narratives, like Michael Jordan's iconic basketball career and the ongoing riva transformative effectlry between Ronaldo and Messi. However, the rise of artificial intelligence (AI) technology is significantly transforming the current sports landscape. AI is now seen as an essential component of industry operations, affecting everything from refereeing decisions to player strategy development and fan engagement. No longer just a supplementary tool, AI is increasingly vital in reshaping the dynamics of competitive sports (Barlow and Sriskandarajah, 2019). This technological shift will alter performance aspects and enhance the overall fan experience. It prompts a deeper exploration of AI's intricate capabilities, raising critical questions about its influence on traditional concepts of fairness, judgment, and human involvement in sports. The application of AI in sports decision-making has sparked extensive research, particularly regarding its role in enhancing fairness and minimizing human error. A prominent example is FIFA's implementation of Goal-Line Technology (GLT) during the 2012 World Cup, which was lauded for ensuring accurate refereeing decisions at crucial moments. Funk (2017) notes that these technologies exemplify how AI redefines the conventional limits of human judgment by offering more data-driven and equitable decision-making processes. The field has since broadened to incorporate other technologies, such as the Video Assistant Referee (VAR) system, further embedding AI into the core regulatory framework of football (Naraine and Wanless, 2020). As AI continues to gain traction, the adjudication and perception of sports outcomes may experience a significant transformation. This challenges theoretical frameworks focusing on fairness, accuracy, and human error (Kong, 2020; Chamorro-Atalaya et al., 2023).

Besides officiating, the application of AI in sports management and strategy development is on the rise, transforming perceptions of work and operational efficiency in the sports industry. Artificial intelligence (AI) enhances human expertise by processing vast amounts of data in real-time. By analyzing enormous volumes of data in real-time, artificial intelligence (AI) improves human knowledge. The Tour de France, which uses machine learning to predict performance, is a noteworthy example (Galily, 2018).

Large-scale datasets like as rider biometrics, topography, weather, historical performance, and even real-time race dynamics are analysed by machine learning algorithms in this context. Teams and analysts may forecast individual rider performance, improve tactics, and even foresee possible results throughout the demanding multi-stage cycling race thanks to this study. This application demonstrates how AI goes beyond straightforward data collection to offer predicted insights that have the potential to greatly impact choices in intricate, high-stakes situations.Conversations surrounding human-machine collaboration theory are becoming more significant, particularly regarding the influence of AI on fan engagement and team strategy. As AI increasingly assumes analytical responsibilities, the roles of analysts, coaches, and even athletes are evolving. Human work is now focused on creativity, intuition, and higher-level decision-making. Existing theories on work, strategy, and fan engagement in sports need to be reevaluated to consider the changing interplay between AI and human knowledge (Haenlein and Kaplan, 2019). Therefore, how AI is revolutionising multiple sports, from NBA fan fascination to AI-driven refereeing systems like FIFA's goal-line technology, is examined. This shows that the widespread use of AI in sports has triggered scientific investigations, making it important to map and visualise patterns in this evolving topic, which will be the basis for the methods.

Under these circumstances, bibliographic analysis has emerged as an important tool for methodological research on the development of a scientific discourse on artificial intelligence in sports and sports economics. By tracing the evolution of publications and collaborations from 1975 to 2023, this study aims to provide insights into how scientific interest is keeping up with the technological advances described in the introduction. The techniques used, including keyword analysis and co-author attribution, represent key themes, trends, and research networks that have emerged with the growing role of artificial intelligence in sports. The relationships show how science is changing at the same pace as artificial intelligence is transforming the sports field. This suggests the need for a thorough review of how the scientific literature addresses the application of AI in sports. Bibliographic studies provide an analytical lens to understand how research responds to advancements impacting contemporary sports.

Theoretical contributions

This study expands and refines existing theoretical frameworks that explore the relationship between technology and sport, with a particular emphasis on the growing significance of artificial intelligence (AI). It examines how AI is reshaping various aspects of sports, including refereeing, athlete performance, fan engagement, and strategy formulation. By doing so, it contributes to the ongoing academic discussion about how technological advancements are altering the core dynamics of sports competition. The article sheds light on how AI is redefining established norms in sports, particularly in areas that have traditionally relied on human judgment, such as officiating and strategic planning. A thorough exploration of AI's role in the decision-making process, particularly its incorporation into existing systems, is a crucial element of this research. This article also looks at the application of AI in sports management and officiating, highlighting examples like FIFA's goal-line technology and the NBA's implementation of chatbots. These innovations challenge conventional theories regarding human error, fairness, and the relationship between fans and sports. The study examines how AI influences split-second decision-making in critical situations, offering insights into its emergence as an essential tool for enhancing the fairness and precision of sports results. AI has shown a transformative effect on sports team management and strategy, improving fan experiences through personalised engagement methods and optimising athlete performance. This study provides a comprehensive analysis of the role of AI in developing the commercial and economic aspects of sports and demonstrates how it can improve and streamline these processes.

This paper is crucial for understanding the economic effects of artificial intelligence on the sports industry. One of the most intriguing aspects of this study is how AI is reshaping jobs within the sports sector. The findings show AI has the potential to revolutionise the roles of analysts, coaches, and players by handling repetitive and time-consuming data tasks. Since creativity, intuition, and strategic thinking remain vital to athletic performance, this shift will enable human professionals to concentrate more on these essential areas. It significantly contributes to the discussion about the future of employment in sports, particularly regarding the evolving relationship between human expertise and AI capabilities. This study enhances theoretical concepts surrounding human-machine collaboration, especially in the realm of sports. It sheds light on how human skills and artificial intelligence can complement each

other rather than compete. By illustrating that AI's role is to enhance human judgment rather than replace it, this study fosters a deeper understanding of the collaborative potential between AI-driven data analysis and human intuition in sports decision-making. This theoretical insight aligns with ongoing discussions in behavioural economics, which focus on balancing human decision-making with technological efficiency.

Practical contributions

This study offers valuable insights for athletes, sports organisations, and lawmakers. Examining current trends in AI applications within sports illustrates how technologies like machine learning in cycling and Hawk-Eye in tennis can enhance viewer engagement and sports performance. The research emphasises practical uses of AI, such as minimising human error in game management, enhancing strategic decision-making through real-time data analysis, and improving injury prevention with wearable robots. These examples create a clear pathway for sports companies aiming to incorporate AI into their operations to boost productivity and competitiveness in a data-driven sports landscape. Beyond practical insights, the study also presents actionable recommendations to tackle the ethical and legal challenges of integrating AI into sports. Key issues discussed include privacy concerns, the risk of AI bias, and the potential pitfalls of over-relying on machine algorithms for decision-making. This research equips sports professionals with valuable guidance on how to navigate these challenges while harnessing AI's potential to foster industry innovation by identifying issues and suggesting solutions. These contributions are crucial to ensure that AI's application in sports is not only effective but also ethically sound and sustainable.

Economic Impact of AI on Sports and the Digital Economy

The economic impact of artificial intelligence (AI) on the sports industry and the wider digital economy is substantial, reshaping revenue streams, labour markets, and business models. Incorporating AI in sports has not only enhanced fan engagement and performance but has also yielded considerable economic advantages. Specifically, AI has opened up new markets within the sports sector and fostered the growth of the digital economy. A prime example is the emergence of AI-driven fantasy sports platforms, which have turned a niche market into a global industry valued in the billions. These platforms use AI to deliver real-time data analysis and personalised recommendations, reaching

millions of users worldwide. Companies like DraftKings and FanDuel have established a new digital economy centred on sports entertainment, generating significant revenue and growth through subscriptions, advertising, and partnerships. Another significant economic effect of AI in sports is clear in the media and broadcasting sector, where AI's role in automating and enhancing sports reporting has transformed content production and consumption. AI-powered systems can now quickly generate highlight videos, analyse match statistics in real time, and customise content for various audience segments. This has resulted in a rise in digital sports media companies that harness AI to offer more dynamic and engaging content to fans. A notable instance is WSC Sports, an AI-driven platform that provides automated video highlight services for major leagues like the NBA, La Liga, and MLS. By leveraging AI, these companies can lower production costs while boosting both the quantity and quality of their content, contributing to the growth of the digital economy through new advertising opportunities and subscription models.

AI has significantly changed another vital aspect of the digital economy: sports betting. By utilising AI to predict match outcomes and analyse betting trends, the industry has become more efficient and tailored to consumer needs, leading to the rapid growth of online sports betting. Companies like Bet365 and William Hill have embraced AI technology to enhance their forecasting abilities and optimise their operations, which has resulted in increased sales and market share. The influence of AI in this field not only boosts customer engagement but also helps companies spot trends and manage risks more effectively, contributing to a stronger and more profitable industry. This blend of AI and sports betting shows how technology can transform the economic landscape and create new digital revenue opportunities. The economic effects of AI in sports also extend to job opportunities and employment growth. While there are worries that certain positions in the sports sector, such as data analysts and content creators, may be replaced by AI, it is also generating a demand for new skills and professions. For instance, roles in AI development, data science, and machine learning are becoming increasingly important in sports organisations and media companies. A notable example of this trend is Manchester City's City Football Group, which has made substantial investments in AI to assess player performance and enhance training. This investment has not only led to better on-field performance, but has also created highly skilled positions within the organisation. These changes show AI is not merely displacing jobs but is also fostering the growth of a more specialised workforce in the sports industry.

AI's economic impact on sports also reaches into global sponsorship and partnership agreements. By offering detailed insights into fan behaviour and engagement, AI enables sports organisations to deliver greater value to sponsors, leading to more lucrative, data-driven sponsorship arrangements. For instance, IBM's AI-driven analysis of Wimbledon's social media interactions allowed the tournament to furnish sponsors with real-time insights into fan sentiment and brand visibility, resulting in more focused and effective marketing strategies. These AI-generated insights empower sponsors to optimise their investments and ensure their marketing efforts resonate with audiences, ultimately fostering economic growth within the sports sponsorship landscape. This illustrates how AI is reshaping sports from a technological standpoint and exerting broader economic influences across both sports and the digital economy at large. Researchers are increasingly focusing on bibliometric review studies concerning artificial intelligence in sports. Prahani et al. (2022) conducted a bibliometric analysis of advancements in artificial intelligence in sports over the past decade (2011-2021) using the Scopus database. They gathered relevant information on trending topics through their VOSviewer mapping of 457 publications. Artificial intelligence is becoming increasingly prevalent at all levels of sports. A review of applications used by university students aimed at enhancing sports activities through artificial intelligence examined 210 publications published between 2013 and 2023 (Chamorro-Atalaya et al., 2023).

Due to the potential to improve sports quality, artificial intelligence research is becoming more and more important (Kong, 2020). Through the integration of the various technologies available, this technology allows for the optimisation of instructional approaches. Song and Wang (2020) have produced multiple bibliometric reviews that approach the subject matter from a sports perspective. The application of AI has been explored from various angles in the works that have been generated; however, there aren't many exclusive scientific mapping studies on AI teaching strategies. For this reason, bibliometric features must be investigated to visualise the state of the art and evaluate research propensities. With the use of artificial intelligence (AI), this paper intends to do a bibliometric analysis of the issue of sports approaches. In this sense, the goal is to visualise the entire volume according to the following: the trajectory of scientific production and keywords.

Table 1. Database search query

Variable	Definition
Database	Scopus, WOS, Google Scholar
Data	01.01.1975-31.12.2023
Years	48
Categories	Sports
Language	English
Search equation	TITLE-ABS-KEY ("artificial intelligence", "sports economics", "sports education", "digital economy", "artificial intelligence technologies", "e-learning", "sports performance", "sports industry", "sports equality")
Result	1037
Refine search	
Type of document	Articles
Result	598 (Articles)

This table details a comprehensive literature review methodology conducted in specific academic databases. The study targeted publications covering 1 year between January 1975 and December 31, 2023, spanning 48 years. The search was conducted through peer-reviewed databases such as Scopus and Web of Science (WOS), which index a large portion of the scientific literature, as well as Google Scholar, to scan for more extensive sources. The combined use of these three databases allowed the relevant literature to be captured at maximum levels and provided a comprehensive analytical framework. The search is restricted to publications in the English language and is the main language of this international academic community. Only sports category is used in the research. The search equation used is "artificial intelligence", "sports economy", "sports education", "digital economy", "artistic intelligence technologies", "e-learning", "sports performance", "sports industry industry, stated in this article; expression As a result of this first query, 1037 documents were obtained, after which these results were filtered according to the "Articles" document type and finally reduced to 598 articles. These 598 articles form the basis of the study's literature review.

Method

The economic impact of artificial intelligence (AI) on the sports industry has led to a significant transformation in areas such as media, publishing, sports betting and fantasy sports. These developments have not only revolutionised traditional sources of income but have also paved the way for the emergence of new digital markets. AI applications from companies such as FanDuel, WSC Sports and DraftKings make significant contributions to the global economy by showcasing the critical convergence of sport, digital economy and AI.

Simultaneously with these economic breakthroughs, academic research into the use of AI in the field of sport has also shown a dramatic increase. Bibliometric research shows that scientific publication output has increased since 2017 and reached a significant peak between 2022 and 2023. This trend coincides with the period when AI-powered sports practices (such as media services and sports betting algorithms) are beginning to have a significant economic impact. The increase in the number of articles on this topic shows that the sports industry is increasingly realising the potential of AI to transform not only fan interaction and sports performance, but also sports-related economic sectors such as the digital economy.

This study adopted a comprehensive bibliometric method to quantitatively analyse the impact of artificial intelligence on the sports economy and trends in the relevant academic literature. Literature review is restricted to English publications covering the 1st year period from January 1975 to December 31, 2023. The data collection process was carried out through Google Scholar databases, which offer more extensive resources with Scopus and Web of Science (WOS), which focus on peer-reviewed publications. Searching for keywords, article titles, abstracts and keywords (TITLE-ABS-KEY) such as "artificial intelligence", "sports economics", "digital economy", "e-learning" has yielded a total of 1037 documents from 1 academic category. These initial results were filtered only by the "Articles" document type, ultimately downgraded to 598 articles, and these articles formed the basis for the analysis.

Several bibliometric techniques, such as publication trends, citation analysis, author and institution analysis, keyword co-formation and common attribution analysis, were applied to the final 598 articles. However, the study has limitations such as potential restrictions on database and search query coverage, language limitation (only in English), and failure to perform in-depth qualitative analysis of content due to the nature of bibliometric analysis. In addition, the fact that the most current data is from the end of 2023 has led to the fact that the latest developments in this rapidly developing field are not fully reflected. Despite these limitations, this analysis provides a solid quantitative basis for understanding the current state of artificial intelligence in the sports economics literature and identifying future research directions.

Result

The findings of the number of publications about sports, AI, and the digital economy are shown in Figure 1. From 1975 to 2023, a total of 598 items were gathered. The first study paper was published in 1979. After a six-year gap, it was continued, and another publication was noted in 1986. One publication was released in 2003, following a three-year break following 1999. A total of twenty-one articles were published between 1986 and 1999. The production volume started to rise in 2017 (11), with 16 documents produced in 2018, and then 21 articles in 2019. The number increases to 48 in 2020, reaches its maximum peak of 183 in 2022 (or 30.6% of all articles), and reaches 197 publications in 2023.
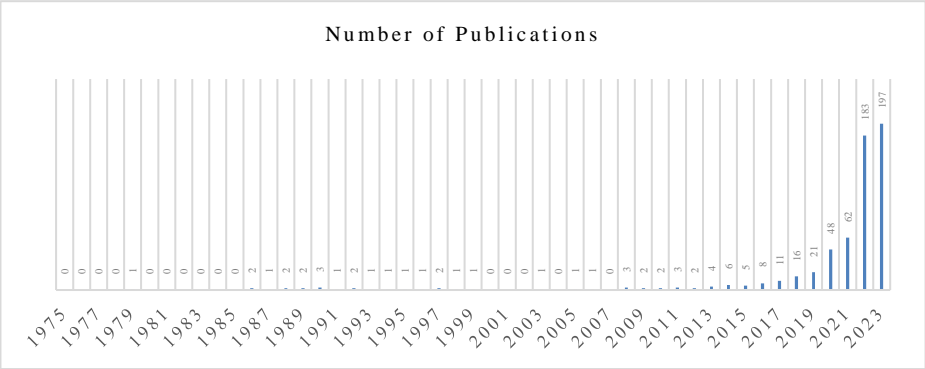
**Fig 1.** Number of publications per year on AI, digital economy and sports
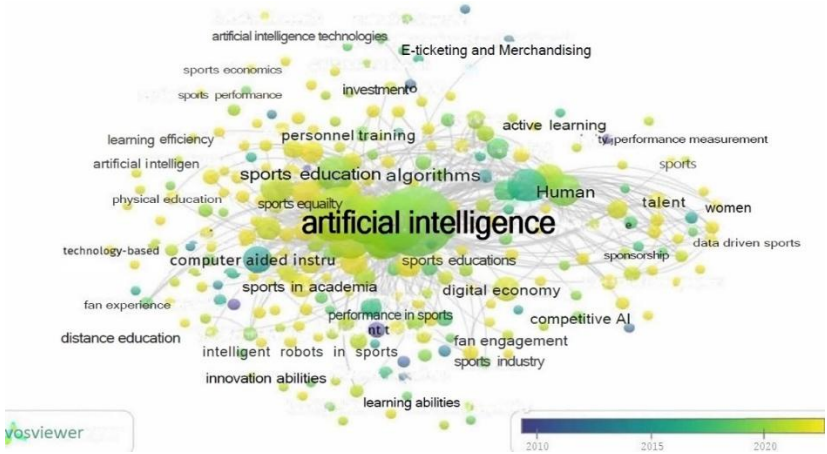
Fig 2. Scientific map of keywords AI and sports between 1975 and 2023

Figure 2 shows the scientific mapping of keywords based on AI and sports. A minimum of three words was set as a criterion, and approximately 3,000 words were identified, of which 598 reached the threshold. The terms showing the highest node magnitude are "sports" (518 times), followed by "artificial intelligence" and "sports economics" (217 and 208 times), another important word "sports education" (119 times); followed by "digital economy" (71 times), "e-learning" (68 times), "artificial intelligence technologies" (64 times), "sports performance" (58 times), "sports industry" (47 times), "competitive AI" (41 times), "sports equality" (37 times). According to the VOSviewer visualization overlay, in 2010 (blue) the themes of "fan engagement", "sports education", "active learning", in 2015 (yellow) "data-driven sports", "physical education", "sports in academia", "personal training" in 2020 (green) the theme of "artificial intelligence" and "artificial intelligence technologies", appears very strongly and in 2023 the themes that emerge are: "sports education algorithms", "learning abilities" and "computer aid instructions".

Conclusion

The integration of artificial intelligence (AI) into the sports industry represents a revolutionary step that will not only transform key areas of operations, management and strategy, but will also change the scope of the economic landscape of sports and digital inclusion. Artificial intelligence has evolved from a tool to become an integral part of sports, helping with decision-making, interacting with fans, and distributing tasks. Technical case studies such as FIFA's Goal Line Technology (GLT) and the Tour de France's machine learning show the impact of AI in reducing human error and increasing accuracy in match decision-making. The impact of this technology on sports is far-reaching, as evidenced by AI-powered platforms changing fan engagement and economic models across fantasy sports, media and advertising.

This study's bibliographic analysis presents an academic approach to the use of artificial intelligence in sports, following the rise of interest in artificial intelligence from the late 1970s to 2023. The significant growth of publications after 2017 reflects the global developments in AI technology across a wide range of fields, highlighting the link between digital innovation and the sports economy. Keywords such as "digital economy," "physical education," and "artificial intelligence" describe the role of artificial intelligence in the sports industry, as well as new markets and career opportunities and business models

will continue to emerge.

This paper contributes to discussions about human-machine collaboration, and artificial intelligence complements rather than replaces human expertise, especially in areas such as sports management and strategic decision-making. The change in the roles of coaches, analysts and athletes shows the need to rethink the traditional methods of work and skills in sports, as artificial intelligence does analytical work, allowing human workers to focus on creativity and imagination. From an economic perspective, artificial intelligence is driving significant changes in sports-related revenue streams and business models. The development of AI platforms in sports betting, fantasy sports, and advertising shows how AI can drive economic growth in the digital economy. These technological advances will also help create jobs in areas such as artificial intelligence development, data science and machine learning, and reinforce the important role of artificial intelligence in creating jobs.

In short, the interaction between artificial intelligence and sports is multifaceted and will continue to evolve. Introducing artificial intelligence will not only improve accuracy and decision-making but also reshape the operational, economic, and strategic aspects of the sports industry. As artificial intelligence continues to replace traditional methods, there is a growing need for interdisciplinary research to ensure that technological advances are viewed within a broad theoretical and methodological framework. The future of sports powered by artificial intelligence is not only about rethinking competition but also about how to understand the workforce, fairness and participation of fans in this rapidly changing environment.

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